SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 24
DECEMBER 15, 1970

W70-10034 -- W70-10500

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

A REVIEW OF THE 1969 LITERATURE ON WASTE WATER AND WATER POLLUTION CONTROL.
Journal Water Pollution Control Federation, Vol 42, No 6, p 863-1268, June 1970. 405 p, 3,143 ref.

Descriptors: *Reviews, *Water pollution control, *Waste disposal, *Waste water disposal, Waste treatment, Activated sludge, Biodegradation, Industrial wastes, Economics, Estuaries, Groundwater, Water pollution sources, Path of pollutants, Sewage, Sewers, Thermal pollution, Urbanization, Water supply, Bibliographies, Publications.
Identifiers: *Literature reviews.

A literature review by the Research Committee of the Water Pollution Control Federation covers: analytical methods (analysis of anions, cations, and gases; and instrumentation), biological filters, activated sludge, detergents, anaerobic processes, sludge treatment, disinfection, water reclamation and reuse, storm flow, facilityevaluation, kinetic models, physical and chemical waste water treatment, effects of pollution on aquatic life, eutrophication, thermal pollution, microbiology, oxygen sag, groundwater, marine and estuarine pollution, economics of treatment, standards, and industrial wastes (paper, fermentation, meat, dairy, canning, coal, tannery, steel, petroleum, plating, chemical, and radioactive). (Knapp-USGS)
W70-10267

1A. Properties

HYDROGEN BONDING AND POLYWATER IN CLAY-WATER SYSTEMS,
Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
Philip F. Low, and Joe L. White.
Clays and Clay Minerals, Vol 18, No 1-E, p 63-66, 1970. 4 p, 1 fig, 52 ref.

Descriptors: *Clay minerals, *Water structure, *Water properties, *Hydrogen bonding, Water properties, Water chemistry.
Identifiers: Clay-water systems, Polywater.

In order to explain the long-range alteration of the properties of water by clay surfaces, it is postulated that an ordered water structure is anchored to and propagated away from these surfaces by hydrogen bonding. There is indirect evidence that polywater, or a similar species of water, does exist in these systems. (Knapp-USGS)
W70-10278

02. WATER CYCLE

2A. General

MODEL STUDIES OF TIDAL EFFECTS ON GROUNDWATER HYDRAULICS,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-10034

USE OF THE MASS BALANCE METHOD FOR EXAMINING THE ROLE OF SOILS IN CONTROLLING WATERSHED PERFORMANCE,
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center.
E. Rawitz, E. T. Engman, and G. D. Cline.
Water Resources Research, Vol 6, No 4, p 1115-1123, August 1970. 9 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Rainfall-runoff relationships, *Water balance, *Hydrologic budget, *Subsurface runoff, *Soil water movement, Small watersheds, Percolation, Topography, Hydrograph analysis.
Identifiers: *Soil water-runoff relationships, Mass balance.

A two year preliminary study of the water balance of a 162-hectare watershed in Pennsylvania showed that spring and summer storms produced practically no overland surface runoff during the storms, but these storms did produce typical hydrographs having all the characteristics usually attributed to surface runoff. Less than 5% of the rainfall, and one third or less of the total runoff appeared as storm runoff. Since virtually all the water eventually reaching the stream channels infiltrated the soil and most of it percolated through the soil, the properties of the soil and the amount of water stored in this layer emerge as the most important regulators of runoff in the system. (Knapp-USGS)
W70-10064

APPLICATION OF THE CONVOLUTION RELATION TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,
Arizona Univ., Tucson. Hydrology and Water Resources.
Allen F. Moench, and Chester C. Kisiel.
Water Resources Research, Vol 6, No 4, p 1087-1094, August 1970. 8 p, 5 fig, 1 tab, 5 ref.OWRR Projects A-010 and B-007.

Descriptors: *Recharge, *Surface-groundwater relationships, *Mathematical models, Linear programming, Aquifers, Hydrogeology, Water level fluctuations, Unsteady flow, Dupuit-Forchheimer theory, Synthetic hydrology, Ephemeral streams, Input-output analysis.
Identifiers: Aquifer recharge models.

A linear model that permits calculation of recharge to the water table from a source of finite width and infinite length uses water level measurements made in an observation well near the source and independently estimated aquifer constants. The method requires determination of the input given the output (water level measurements) and the impulse response as a function of space and time. The latter is derived from the linear equations of groundwater motion for the particular geometry of this study. The input is obtained from the discrete form of the convolution integral by using the synthetic division method and is then summed over the appropriate time period to obtain total recharge. For the particular recharge event studies, results agree satisfactorily with an independent estimate of recharge and demonstrate that the convolution relation has practical application to groundwater flow problems. (Knapp-USGS)
W70-10067

APPLICATION OF LINEAR RANDOM MODELS TO FOUR ANNUAL STREAMFLOW SERIES,
Alaska Univ., College; and Wisconsin Univ., Madison.
Robert F. Carlson, A. J. A. MacCormick, and Donald G. Watts.
Water Resources Research, Vol 6, No 4, p 1070-1078, August 1970. 9 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Streamflow forecasting, *Regression analysis, *Time series analysis, *Correlation analysis, Gaging stations, Data collections, Statistical methods, Statistics, Markov processes, Stochastic processes.
Identifiers: Hydrologic series, Streamflow series.

A simple method for describing random time series is illustrated by application to the annual streamflow data of the St. Lawrence, the Missouri, the Neva, and the Niger rivers. The techniques is illustrated for identifying the appropriate form of the general autoregressive moving average model by use of the sample autocorrelation function of each series. The values of the parameters of the suggested model of each series are estimated and the results checked to suggest further modification of the model. The best model for each of the four samples showed a reduction in the variance value to 0.49, 0.64, 0.59, and 0.62 of the original variance with the use of one or two parameters. The use of the model for one year ahead forecasting on the Missouri River data is shown. (Knapp-USGS)
W70-10069

SIMULATION OF SPATIAL AND TEMPORAL CHANGES IN WATER QUALITY WITHIN A HYDROLOGIC UNIT,
Montana State Univ., Bozeman. Dept. of Civil Engineering; and Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 05G.
W70-10077

THE ATMOSPHERIC WATER BALANCE AND THE HYDROLOGY OF LARGE RIVER BASINS,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
James L. Rasmussen.
Water Resources Bulletin, Vol 6, No 4, p 631-639, July-August, 1970. 9 p, 5 fig, 1 tab, 20 ref. OWRR Project B-035.

Descriptors: *Water balance, *Synoptic analysis, *Colorado River Basin, Hydrologic budget, Rainfall-runoff relationships, Climatology, Meteorological data, Meterorology, Regions, Surveys, Evapotranspiration, Discharge (Water), Runoff forecasting, Streamflow forecasting.
Identifiers: Atmospheric water balance.

The concept of using the atmospheric water balance technique in the study of the hydrology of large river basins is described. The atmospheric water balance technique consists of determining the spatial and time distributions and fluxes of water vapor through the atmospheric volume overlying the basin. Precipitation minus evaporation at the earth's surface is determined as a residual of the computation. Results of experiments employing this technique are reviewed. The technique is demonstrated by the hydrometeorology of the Upper Colorado River Basin. The seasonal accumulation of water over the basin is highly correlated with annual runoff. The daily evaporation rate during dry days varies by a factor of 2 over the winter season, and is related to the incoming solar radiation intensity. (Knapp-USGS)
W70-10079

FLOW SERIAL CORRELATION AND RELATED STREAMFLOW GENERATION MODELS,
Washington State Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 02E.
W70-10120

RUNOFF GENERATION IN WESTERN WASHINGTON AS A FUNCTION OF PRECIPITATION AND WATERSHED CHARACTERISTICS,
Washington State Univ., Pullman. Coll. of Engineering Research Div.
John S. Gladwell.
Available from NTIS as PB-194 461, $3.00 in paper copy, $0.65 in microfiche. Completion Report, College of Engineering, Research Division, Bulletin 319, June 1970. 341 p, 56 fig, 46 tab, 74 ref. OWRR A-028-WASH (1).

Descriptors: *Precipitation (Atmospheric), *Discharge (Water), *Hypsometric analysis, Variability, Geomorphology, Regression analysis, Synthetic hydrology, *Watersheds, Correlation analysis, *Runoff, *Rainfall-runoff relationships, Washington.

Twenty-nine watersheds of Western Washington are studied to establish relationships between precipitation and runoff as modified by physiographic characteristics. The relationships are studied using primary statistical parameters of the hydrologic series. It is established that the mean annual discharge and the mean annual hydrograph (using monthly sub-units) are highly correlated to watershed hypsometry. The standard deviation of annual discharge is shown to be generally predictable on the basis of precipitation data; it is also found to be a linear function of the mean annual discharge. Precipitation skewness and kurtosis are shown to be roughly defineable by geographic delineations. Runoff skewness is generally less than

that of precipitation. Kurtosis of runoff is less easily defined but generally has a value of less than three. Annual precipitation appears to be serially correlated, and the correlogram of runoff is shown to be highly correlated to that of precipitation. Cross-correlations of precipitation and of runoff series are shown to be functions of proximity and of a directional component. Harmonic analyses of the runoff and precipitation series indicate strongly that cycles of approximately 16.5 and 5.5 years may exist.
W70-10122

SELECTION OF FREQUENCY DISTRIBUTION MODELS,
Nevada Univ., Reno.
Vulli L. Gupta.
Water Resources Research, Vol 6, No 4, p 1193-1198, August 1970. 6 p, 1 fig, 3 tab, 22 ref.

Descriptors: *Mathematical models, *Statistical models, *Statistical methods, Statistics, Frequency analysis, Hydrologic data, Data processing, Computer programs, Parametric hydrology, Regime, Floods, Droughts.
Identifiers: Frequency distribution models.

A method is considered for selecting mathematical models to fit frequency distributions of hydrologic data among ten commonly used methods of frequency analysis. The methods are those of Gumbel, Lieblein, Chow, and the seven types of Gringorten. The best fitting model is chosen on the basis of comparison for goodness of fit indicated by the coefficients of determination. Friedman's non-parametric statistical test was employed to detect significant differences between the models. (Knapp-USGS)
W70-10246

WATER RESOURCES PROBLEMS: PRESENT AND FUTURE REQUIREMENTS FOR LIFE,
For primary bibliographic entry see Field 06D.
W70-10312

2B. Precipitation

A CRITIQUE OF METHODS SIMULATING RAINFALL,
Imperial Coll. of Science and Technology, London (England).
M. J. Hall.
Water Resources Research, Vol 6, No 4, p 1104-1114, August 1970. 11 p, 3 fig, 1 tab, 43 ref.

Descriptors: *Rainfall simulators, *Artificial precipitation, *Simulated rainfall, *Reviews, *Hydraulic models, Model studies, Equipment, Instrumentation, Design, Research equipment.
Identifiers: Rainfall simulation research.

In natural rainfall the range of drop sizes increases with increasing rainfall intensity. If a network of nozzles is used to generate artificial rainfall, an increase in working pressure increases the average intensity but decreases the range of drop sizes within the spray. This property has hindered the development of the rainfall simulator more than any other single factor. Alternative methods of simulating rainfall, which depend upon individual drop forming elements such as hypodermic needles for example, are capable of producing sprays with uniform drop sizes only. Such methods have been employed successfully in generating storm patterns involving both temporal and spatial variations in intensity for laboratory catchment studies. A general purpose rainfall simulator, combining control of application rates in both space and time with the reproduction of the drop size distributions and velocities of fall of drops observed in nature, has yet to be developed. (Knapp-USGS)
W70-10065

THE nTH ROOT NORMAL DISTRIBUTION OF PRECIPITATION,
Nevada Univ., Reno. Center for Water Resources Research.
Charles K. Stidd.
Water Resources Research, Vol 6, No 4, p 1095-1103, August 1970. 9 p, 9 fig, 3 tab, 12 ref.

Descriptors: *Time series analysis, *Precipitation (Atmospheric), Data collections, Synthetic hydrology, Simulation analysis, Statistics, Statistical methods, Runoff forecasting.
Identifiers: Synthetic precipitation series.

A computer-generated stationary time series was modified by processes analogous to those that produce precipitation. The resulting numbers have the distributional characteristics of precipitation data. A quantitative explanation is thereby obtained for the skewness in precipitation distributions, and the nth root normal distribution is verified. (Knapp-USGS)
W70-10066

A FAST, APPROXIMATIVE METHOD FOR INTEGRATING THE STOCHASTIC COALESCENCE EQUATION,
National Center for Atmospheric Research, Boulder, Colo.
Rainer Bleck.
Journal of Geophysical Research, Vol 75, No 27, p 5165-5171, September 20, 1970. 7 p, 8 fig, 10 ref.

Descriptors: *Raindrops, *Condensation, *Cloud physics, *Stochastic processes, Statistics, Statistical models, Meteorology, Atmospheric physics, Precipitation (Atmospheric).
Identifiers: *Stochastic coalescence (Raindrops), Raindrop coalescence.

The use of mean values of the raindrop number density in the coalescence equation is shown to lead to a system of ordinary differential equations that provide good approximative solutions with a minimum of computational efforts. The coefficients in this system of equations are functions of the kernel and can be obtained by simple quadrature. Comparisons are made between numerical and analytic solutions for two types of kernels (constant and sum of arguments), using a Gaussian initial distribution of cloud droplets. Systematic deviations of the numerical results from corresponding analytic solutions are shown to depend on the choice of variables, and methods to suppress these deviations are discussed. (Knapp-USGS)
W70-10270

2C. Snow, Ice, and Frost

DROPLET FREEZING BY SURFACE NUCLEATION,
State Univ. of New York, Albany.
Narayan R. Gokhale, and James Goold, Jr.
Journal of Applied Meteorology, Vol 7, No 5, p 870-874, October 1968. 5 p, 4 fig, 1 tab, 10 ref.
NSF Grant No GA-328.

Descriptors: *Freezing, *Cloud seeding, *Silver iodide, *Clay minerals, *Nucleation, Cloud physics, Supercooling, Crystallization, Temperature, Snow, Particle size, Crystallography.
Identifiers: Surface nucleation.

Droplet freezing by surface nucleation has been observed during the course of studies of ice nucleation. A constant rate of cooling apparatus and a specially constructed cold chamber were used for this study. Silver iodide particles sprinkled on supercooled, millimeter-size water drops are effective in freezing the drops at -5C. Particles of naturally occurring silicates were found to be effective in the range -7 to -10C. Thus, the ice nucleating ability of such dry particles is much greater by the surface contact mechanism than when particles are embedded in the drops. The importance of the surface nucleation mechanism in forming solid hydrometeors in cumulus clouds is discussed. (K
napp-USGS)
W70-10091

PERMAFROST PRESENTS MECHANICA CHALLENGES,
Kroeker (J. Donald) and Associates, Portlanc Oreg.
For primary bibliographic entry see Field 08A.
W70-10144

NATURAL FREEZING AND THAWING IN A SILT AND A SAND.
Forest Service (USDA), St. Paul, Minn. Nort Central Forest Experiment Station.
Richard A. Sartz.
Soil Science Vol 109, No 5, p 319-323, 1970.

Descriptors: *Frozen soils, *Impervious soils *Thermal properties, *Soil water, *Physical pro perties, Porosity, Soil texture, Hydrologic proper ties, Wisconsin.

Since it can affect infiltration and soil wate storage, soil freezing often affects the hydrology o northern watersheds under winter and early sprin conditions. The rate at which different soils freez and thaw varies with their physical properties a well as with the temperature gradient. Depth o frost penetration and rate of freezing and thawin were studied in field profiles of a sandy and a silt soil. Frost depth was measured by penetromete and resistance blocks and rate of freezing an thawing at a given depth were determined b gradual changes in resistance block readings Although the two soils began to freeze at the sam time, frost penetrated faster and deeper an thawed sooner in the sandy soil. During the sprin thaw frost persisted in the silt 3 weeks longer tha in the sand. Frost undergoes gradual changes dur ing freezing and thawing that may affect it permeability. (Sartz-Forest Service)
W70-10411

SOIL WATER MOVEMENT AS AFFECTED BY DEEP FREEZING,
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 02G.
W70-10414

A DEVICE FOR MEASURING SOIL FROST,
Forest Service (USDA), Upper Darby, Pa Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 07B.
W70-10415

NICHOLS V CITY OF MORRISTOWN (LIA BILITY FOR INJURY DUE TO INADEQUACY OF CREEK TO ACCOMMODATE SURFACE WATER).
For primary bibliographic entry see Field 02E.
W70-10483

2D. Evaporation and Transpiration

EVAPORATION OF BRINE: A FIELD STUDY ON THE BONNEVILLE SALT FLATS, UTAH,
Texas Univ., Austin.
L. J. Turk.
Water Resources Research, Vol 6, No 4, p 1209-1215, August 1970. 7 p, 4 fig, 4 tab, 18 ref.

Descriptors: *Evaporation, *Brines, Utah, Salinity Water vapor, Solar radiation, Vapor pressure Hydrologic budget, Water balance, Evaporation pans.
Identifiers: Bonneville Salt Flats.

Evaporation rates were determined for seve brines of average specific gravities from 1.207 t 1.333. Evaporation of the brines ranged from 70

to 9.5%, respectively, of the freshwater evaporation rate. The field data agree exceptionally well with differential vapor pressures over Great Salt Lake brine. Water occasionally condenses on the heavier brines because of an inverted vapor pressure gradient. (Knapp-USGS)
W70-10059

IMPROVEMENTS IN THE VAN BAVEL-MYERS AUTOMATIC WEIGHING LYSIMETER,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 07B.
W70-10062

SOIL-WATER MOVEMENT AND EVAPOTRANSPIRATION: CHANGES IN THE ISOTOPIC COMPOSITION OF THE WATER,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
For primary bibliographic entry see Field 02K.
W70-10104

IRRIGATION REQUIREMENTS FROM EVAPORATION,
Utah Water Research Lab., Logan.
J. E. Christiansen, and G. H. Hargreaves.
Seventh Congress on Irrigation Drainage, Quest 23, Rep Disc, Part 2, R24-R45, Mexico City, p 23.569-23.596, 1969. 28 p, 11 tab, 28 ref.

Descriptors: Irrigation, *Evaporation, *Evapotranspiration, Equations, *Consumptive use, Irrigation efficiency, Irrigation water, Coefficients, *Irrigation operation and maintenance, Bibliographies, Water requirements, Methodology, Estimating, Forecasting, *Irrigation practices, Scheduling, Crops.
Identifiers: *Irrigation requirement, *Pan evaporation, Christiansen-Mehta Form, *Potential evapotranspiration, Potential evaporation.

Pan evaporation, as measured with a Class A pan under standardized conditions, is a reliable index of climate as it pertains to evapotranspiration. Pan evaporation is being measured in many places in the world, but when not available, may be estimated from many formulas, some of which are included here. Potential evapotranspiration can be estimated from pan evaporation or computed directly from radiation and climatic data. Evapotranspiration varies with crops, but can be estimated best from potential evapotranspiration or directly from pan evaporation. Three formulas are presented for estimating Class A pan evaporation and 4 for estimating potential evapotranspiration. These formulas may be applied in either English or metric units. Coefficients are presented from which actual evapotranspiration may be estimated from either measured or estimated pan evaporation, or from estimated potential evapotranspiration. Irrigation water requirements depend basically upon evapotranspiration, but also depend upon precipitation and water application efficiency. As water resources become more limiting, the need for better estimates of evapotranspiration will increase. (USBR)
W70-10141

EVAPOTRANSPIRATION BY WOODY PHREATOPHYTES IN THE HUMBOLDT RIVER VALLEY, NEAR WINNEMUCCA, NEVADA,
Geological Survey, Washington, D.C.
T. W. Robinson, and A. O. Waananen.
For sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price 55 cents. US Geological Survey Professional Paper 491-D, 1970. 41 p, 26 fig, 11 tab, 9 ref.

Descriptors: *Evapotranspiration, *Phreatophytes, *Nevada, Rabbitbrush, Willow trees, Arid climates, Alluvial channels, Consumptive use, On-site tests, Lysimeters, Water levels, Water table, Groundwater.
Identifiers: Winnemucca (Nev), Humboldt River (Nev).

Evapotranspiration by phreatophytes was studied in the Winnemucca reach of the Humboldt River valley, Nevada. Water that is wasted by evapotranspiration from areas of low beneficial phreatophytes is one of the largest unknowns in the water budget of the reach. Twelve tanks ranging in size from 30 feet square and 10.5 feet deep to 10 feet square and 7 feet deep were constructed. Seedlings of greasewood were planted in 2 tanks and rabbitbrush in 3 tanks; cuttings of willow were planted in 3 tanks and wildrose in 3 tanks. The twelfth was left bare. The tanks were operated during the growing season April 1 to October 20 from 1961-67, inclusive. Water metered into elevated reservoirs was supplied by gravity to the evapotranspiration tanks. Evapotranspiration by a given species of phreatrophytes is affected by climatic conditions, of which temperature is the most important. Water use by greasewood and rabbitbrush in April was only about 2% of the yearly total, whereas during the months of peak use it was 28%. More than two-thirds of the annual use occurred during June, July, and August. The annual use of water ranged rather widely over the study period, as the plants responded to the effect of plant damage, boron toxicity, depth of the water level, and warmth and length of the growing seasons. Draft from the water table, equivalent to the water supplied to the tanks, varied with the rainfall. It was greatest when rainfall was scant, and least when the rains were copious. (Knapp-USGS)
W70-10243

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
Virginia Univ., Charlottesville. School of Engineering and Applied Science.
J. Taylor Beard, and John L. Gainer.
Journal of Geophysical Research, Vol 75, No 27, p 5155-5163, September 20, 1970. 9 p, 6 fig, 5 tab, 21 ref. OWRR Project A-019-VA and USBR Contract 14-06-D-6385.

Descriptors: *Evaporation control, *Monomolecular films, *Solar radiation, *Albedo, Reservoir evaporation, Alcohols, Oil, Dye releases.
Identifiers: Reflectance, Colored monolayers.

Evaporation in water reservoirs may be reduced by increasing the reflectance of solar energy. Such a change in reflectance will require a surface modification such as the application of a special surface film or monolayer with good reflecting properties. Colored monolayers and artificially dyed monolayers were studied experimentally. A large number of dyes were investigated, but in no instance did the dyes color the monolayer or form a monolayer themselves. A yellow silicone oil film on a water surface was found experimentally to relect solar energy about 1.7 times better than a plain water surface and also to reduce the evaporation rate. In addition, the film was extremely difficult to remove from a water surface. The transient energy equation for an element of a water surface was solved by numerical methods. The analytical model gave an average evaporation suppression by cetyl alcohol of 22.6%, which is consistent with previous experimental work. Results for monolayers with hypothetical reflectance properties and with the diffusion properties of a cetyl alcohol monolayer showed average evaporation reductions of 25 to 45%, depending on the reflection properties. (Knapp-USGS)
W70-10271

IMPROVING TREE TRANSPIRATION ESTIMATES BASED ON HEAT PULSE VELOCITY MEASUREMENTS,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Robert H. Swanson.
International Union Forestry Research Organization Congress, Sept 4-9, 1967, Munich, Germany, Vol 1, Section 11, p 252-263, 1967. 6 fig, 8 ref.

Descriptors: *Transpiration, *Trees, *Respiration, *Circulation (Plants), Consumptive use, Analytical techniques, Heat flow, Density.
Identifiers: Heat pulse velocity (Trees).

To estimate tree transpiration from heat pulse velocity, the mean sap flux and the area of the sap stream in cross section must be known. Sap flux is computed from heat pulse velocity, wood moisture content, density, and specific heat. This paper shows that the cross-sectional area within which sap ascends, the moisture content, and density of the conducting wood are not constant. Changes in these values must be considered before comparative transpiration estimates from heat pulse velocity are made. (Knapp-USGS)
W70-10286

THE EXPECTED EFFICIENCY OF WATER UTILIZATION IN PLANTS UNDER DIFFERENT COMPETITION AND SELECTION REGIMES,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
D. Cohen.
Israel Journal of Botany, Vol 19, No 1, p 50-54, March 1970. 4 ref.

Descriptors: *Water utilization, *Efficiencies, *Photosynthesis, *Transpiration, *Competition, Stomata, Semiarid climates, Climatology, Soil moisture, Soil surfaces, Plant physiology, Root systems, Consumptive use, Soil-water-plant relationships.
Identifiers: *Selection, Mediterranean climates.

The ratio of net photosynthesis to transpiration may be called the efficiency of water utilization for photosynthesis. Since changes in such factors as temperature, humidity, and light intensity influence rates of photosynthesis and transpiration, the ratio shows great daily and seasonal variation. If plants open their stomata only when efficiency is high, then plants will grow slowly but efficiently. However, if plants open their stomata when efficiency is low, then they grow quickly but inefficiently. Competition and selection appear to favor plants which grow quickly and remove soil water before it can be utilized by slow-growing plants. Therefore, high efficiency should occur naturally only if root systems of individual plants are not near the soil surface and do not overlap the root systems of other plants. This paper is based on studies of plant water utilization in Mediterranean climates. (Carr-Arizona)
W70-10294

EVAPOTRANSPIRATION ESTIMATES IN A SEMIARID CLIMATE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
W. L. Pelton, and H. C. Korven.
Canadian Agricultural Engineering, Vol 11, No 2, p 50-53, 61, November 1969. 4 fig, 1 tab, 16 ref.

Descriptors: *Evapotranspiration, *Equations, *Irrigation practices, *Scheduling, *Semiarid climates, Alfalfa, Water requirements, Irrigation efficiency, Irrigation, Timing, Meteorological data, Lysimeters, Estimating, Estimating equations.
Identifiers: *Saskatchewan (Canada), *Penman equation, *Thornthwaite equation *Blaney-Criddle equation, *Irrigated agriculture, Canadian Prairie.

Three methods of estimating evapotranspiration from meteorological data were tested on irrigated alfalfa (Medicago sativa) at Swift Current, Saskatchewan, Canada. For 53 days during the 1967 growing season lysimeter observations were compared to evapotranspiration estimates from the Penman, Thornthwaite, and Blaney-Criddle equations. The latter two methods predicted weekly water requirements of alfalfa with reasonable accuracy, but described actual daily evapotranspiration inadequately. Although the Penman equation would require modification before being acceptable for general use on the Canadian Prairie, it was able to account for 65 percent of the variation in daily evapotranspiration. Further evaluation is necessary to test these equations for monthly and seasonal use. (Carr-Arizona)
W70-10297

EVAPORATION--RAIN FALLING UP,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.

Charles A. Troendle, and James D. Phillips.
West Virginia Agriculture and Forestry Vol 3, No 2, p 5, 11, 12, Spring 1970.

Descriptors: *Evaporation, *Evapotranspiration, *Solar radiation, Advection, Air temperature, Climatic data, Humidity, Wind velocity, West Virginia.
Identifiers: *Evaporation pan, Barometric pressure, Daily evaporation, Lake evaporation.

Data collected at the U. S. Weather Bureau Climatic Station at the Timber and Watershed Laboratory in Parsons, W. Va. were used for a twofold analysis. First, equations were developed for estimating daily pan evaporation from solar radiation, wind speed, air and water temperatures, and barometric pressure. The best overall estimator of pan evaporation was: Pan Evaporation—Daily Radiation..Mean Air Temperature. Then, the factor used to estimate potential evapotranspiration from pan evaporation was corrected for local climatic conditions. The corrected factor averaged 0.78 for May through September. (Troendle-Forest Service)
W70-10419

THE RADIANT ENERGY BUDGET OF CLEAR-CUT AND FORESTED SITES IN WEST VIRGINIA,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
J. W. Hornbeck.
Forest Science Vol 16, No 2, June 1970, p 139-145.

Descriptors: *Albedo, *Energy budget, *Snow cover, *Solar radiation, Advection, Air temperature, Climatology, Convection, Evapotranspiration, Heat balance, Heat transfer, Microclimatology, Radiation, Wind velocity, Clear-cutting, West Virginia.
Identifiers: *Hardwood forests, Radiant energy budgets, Radiometers.

Radiant energy budget components were measured over a clearcut site and a hardwood forest site on a gaged watershed in West Virginia. Results show that clearcutting caused changes in both albedo and upward thermal radiation values. The magnitude of these changes varied by season of the year. The clearcutting had an albedo that was nearly constant at 14 percent during snowfree conditions but ranged up to 83 percent during periods of snow cover. On the other hand, the forest albedo ranged from 14 percent for a leafless and snowfree period to about 20 percent for full leaf conditions and to 32 percent during periods of snow cover. The clearcutting had greater upward thermal radiation losses except during periods of snow cover when both sites were nearly identical. Despite the seasonal variability, net radiation values for the two sites did not differ greatly except during periods of snow cover. (Hornbeck-Forest Service)
W70-10422

2E. Streamflow and Runoff

LEAST SQUARES ESTIMATION OF CONSTANTS IN A LINEAR RECESSION MODEL,
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 06A.
W70-10052

VALUE OF STREAMFLOW DATA FOR PROJECT DESIGN-A PILOT STUDY,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins; Corps of Engineers, Sacramento, Calif; and Geological Survey, Washington, D.C. Hydrologic Systems Lab.
S. R. Dawdy, H. E. Kubik, and Edward R. Close.
Water Resources Research, Vol 6, No 4, p 1045-1050, August 1970. 6 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Streamflow forecasting, *Planning, *Stochastic processes, *Simulation analysis, *Data collections, Design, Statistical methods, Statistics, Data processing, Water yield, Cost-benefit analysis, Synthetic hydrology, Water costs, Reservoir desing, Hydraulic design.

The value of streamflow data for project design is related to benefits forgone because of insufficient streamflow data. Stochastic simulation of a long-term hypothetical record for a sample station is used to determine a reservoir design based on full (hypothetical) information. Shorter segments of the long-term trace are then used for design under the same criteria in order to compute benefits forgone as a result of lack of full information. For the station used in this study, a low mean flow, high variability station, the marginal value of streamflow data approaches the marginal cost at some time beyond the length of 100 years. The manner in which the value of streamflow data for project design can be evaluated is illustrated. (Knapp-USGS)
W70-10056

OPTIMUM OPERATING PROCEDURE FOR A RIVER GAGING STATION ESTABLISHED TO PROVIDE DATA FOR DESIGN OF A WATER SUPPLY PROJECT,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-10057

A NUMERICAL SOLUTION FOR FINITE AMPLITUDE FREE SURFACE WAVES,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 07C.
W70-10060

THE FRICTION COEFFICIENT FOR SHALLOW FLOWS OVER A SIMULATED TURF SURFACE,
University of the West Indies, St. Augustine (Trinidad).
H. O. Phelps.
Water Resources Research, Vol 6, No 4, p 1220-1226, August 1970. 7 p, 2 fig, 1 tab, 7 ref.

Descriptors: *Overland flow, *Roughness (Hydraulic), *Turf, *Hydraulic models, Fluid friction, Reynolds number, Energy losses, Discharge (Water), Flow resistance, Hydraulics, Porous media, Flumes, Mathematical models, Laminar flow, Turbulent flow.
Identifiers: Overland flow over turf.

The friction coefficient of rough surfaces must be known for the application of the basic momentum and continuity equations to the modeling of overland flow. Flume experiments on steady, uniform flows in the laminar and transitional regions over a simulated turf surface provide the data required to investigate the general hydraulic roughness properties of natural turf, and the particular parameters that are likely to influence the friction coefficient. Because boundary geometry depends on flow depth, this factor must be considered in calculating the relationship between friction coefficient and Reynolds number. By maintaining constant depths while varying the Reynolds number, the separate effects of boundary geometry and Reynolds number on the friction coefficient are demonstrated. The results, which are presented in the form of a friction coefficient chart, may be rationally explained if the simulated turf is considered to be a complex porous medium in which the boundary geometry is variable. (Knapp-USGS)
W70-10061

THE MEASUREMENT OF GRADATION USING SURVEYED CROSS SECTIONS,
Forest and Range Experiment Station, Rangiora (New Zealand).
F. A. Johnson.
Water Resources Research, Vol 6, No 4, p 1230-1234, August 1970. 5 p, 7 fig, 1 tab, 1 ref.

Descriptors: *Stage-discharge relations, *Alluvial channels, *Hypsometric analysis, *Slopes, *Cross sections, Profiles, Surveys, Streams, Channel morphology, Elevation.
Identifiers: Stream channel surveying.

A variation of hypsometric analysis gives quantitative information on relative changes within a river cross section. Area-elevation curves and area-distance curves determine the degree of activity of segments of a cross section. (Knapp-USGS)
W70-10063

THE nTH ROOT NORMAL DISTRIBUTION OF PRECIPITATION,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 02B.
W70-10066

ESTIMATING COEFFICIENTS OF A FLOW GENERATOR FOR MONOTONE SAMPLES OF DATA,
American Univ., Washington, D.C.; and Geological Survey,
For primary bibliographic entry see Field 07A.
W70-10068

EVOLUTION OF TIDEWATER PORT,
Tulane Univ., New Orleans, La. School of Engineering.
For primary bibliographic entry see Field 08B.
W70-10088

STREAM GAUGING TECHNIQUES FOR REMOTE AREAS USING PORTABLE EQUIPMENT,
British Columbia Univ., Vancouver. Dept. of Geography; and Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 07B.
W70-10090

CAPABILITIES AND POTENTIAL OF USAEC'S CURRENT METER FOR ULTRA-LOS-VELOCITY MEASUREMENTS,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 07B.
W70-10108

THE FLOW OF A STREAM THROUGH A RESERVOIR,
Gemeinnutziges Institut, Duesseldorf (West Germany).
K. Sauerwein.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/48, p 697-719, 1967. 23 p, 14 fig, 1 tab.

Descriptors: *Currents (Water), *Reservoirs, *Tracers, *Radioisotopes, Radioactivity techniques, Dye releases, Streamflow, Mixing, Dispersion.
Identifiers: Reservoir flow.

If a reservoir is fed from a single source, which may not always be pure, the extent to which the inflowing stream mixes with the water in the reservoir is important for the quality of the water supplied by the reservoir. The question was investigated at the Lingese Reservoir, containing between one and two million cubic meters of water, in the Bergisches Land (North Rhine-Westphalia). The investigation was carried out at four different seasons so that the varying effects of the stream-water temperatures could be studied in relation to the temperature of the reservoir water. The stream was radioactively labeled at the point of inflow into the reservoir, and its flow through the reservoir was measured in length and depth from boats, by means of l-m-long

Geiger counters. Comparisons were made with simultaneously performed dye and slat experiments, but the four isotope experiments carried out at different seasons were found to be more suitable than the other procedures for investigating limnological processes and evaluating them quantitatively. (Knapp-USGS)
W70-10111

FLOW SERIAL CORRELATION AND RELATED STREAMFLOW GENERATION MODELS,
Washington State Univ., Seattle. Charles W. Harris Hydraulics Lab.
William J. Stolte, and Eugene P. Richey.
Available from NTIS as PB-194 459, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Charles W. Harris Hydraulics Laboratory Technical Report No. 29, June 1970. 154 p, 23 fig, 16 tab, 35 ref. OWRR A-035-WASH (1).

Descriptors: Hydrology, Stochastic processes, Runoff, Climatic factors, Flow, *Flow characteristics, *Model studies, *Hydraulic models, Synthetic hydrology, Washington, Statistical models, River basins, Regression analysis.

The goal of the research was to investigate both the mathematical and physical aspects of flow generation processes. The mathematical aspect of the study indicated that the statistics of annual and monthly flows are intrinsically related. Therefore it is desirable that generated monthly flows should yield acceptable annual flows. Multiple regression equations incorporating from 1 through 12 preceding flows as predictor variables were used to generate monthly flows from which annual flows were derived. The statistics of both the monthly and annual flows gained by this process, were compared to those of the recorded flows in order to determine the accuracy of flow generation by these models and to choose the most acceptable model. It was found that the lag 1 model was the most desirable but that it had deficiencies in some respects. The physical aspect of flow generation was studied by determining the physical causes of, and prediction equations for, a poorly understood component of the lag 1 flow generation model, namely, the lag one serial correlation coefficient. It was found that the influence of climate on the serial correlation coefficient strongly predominates over that of basin characteristics in the region studied. It was concluded that groundwater storage was not of great importance in the variation in the flow serial correlation from basin to basin. It was also found that the prediction equations for the lag one serial correlation coefficient were deficient in some respects and could not be used with great confidence. More work is needed in developing accurate indices of the various physical causes influencing the flow regime. These results are not necessarily applicable to other regions where climatological and geographic conditions are different from those of Western Washington.
W70-10120

INTERNAL CURRENTS RESULTING FROM INTERMEDIATE DENSITY INFLOWS INTO STRATIFIED RESERVOIRS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
Walter F. Rittall, and Bruce W. Hunt.
Available from NTIS as PB-194 460, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Charles W. Harris Hydraulic Laboratory, Technical Report 28, June 1970. 32 p, 17 fig, 5 ref. OWRR A-023-WASH (1).

Descriptors: *Stratified flow, *Hydraulic jump, Density currents, *Reservoir, Flow, *Density stratification, Depth, Froude number, Reynolds number, Slopes, *Open channel flow.

An experimental study has been made of the flow pattern which results when an inflow of intermediate density enters along the sloping bottom of a two-layer, density-stratified reservoir. It was found that a hydraulic jump may form within the reservoir at the fluid interface, and much of the study was focused upon the characteristics of this jump. It was found during the course of the study that the ratio of downstream to upstream jump depth depends mainly upon the ratio of densities across the top fluid interface, the channel slope, a densimetric Froude number, and a Reynolds number. Difficulties arose during the study because of the impossibility of controlling both the Reynolds and Froude numbers simultaneously. However, by combining the results of this study with two other related studies, it was found possible to extrapolate approximate depth relationships for flows at higher Reynolds numbers.
W70-10121

RUNOFF GENERATION IN WESTERN WASHINGTON AS A FUNCTION OF PRECIPITATION AND WATERSHED CHARACTERISTICS,
Washington State Univ., Pullman. Coll. of Engineering Research Div.
For primary bibliographic entry see Field 02A.
W70-10122

ADAMS V TOWN OF RUSTON (ACCELERATED EROSION OF NATURAL STREAM BY DISCHARGE OF SWIMMING POOL WATER).

194 La 403, 193 So 688-690 (1940).

Descriptors: *Louisiana, *Swimming pools, *Drainage, *Accelerated erosion, Bank erosion, Degradation (Stream), Soil erosion, Stream erosion, Damages, Superimposed drainage, Drainage practices, Drainage water, Riddance (Legal aspects), Ditches, Swimming, Cities, Judicial decisions, Legal aspects, Water injury, Natural streams, Water conveyance, Drainage systems, Drainage programs, Discharge (Water), Property values.

Plaintiff downstream landowner sought an injunction to prevent defendant city from periodically emptying swimming pool water into a natural drain which traversed plaintiff's unimproved land. Plaintiff claimed the swimming pool water had eroded the drain, causing a diminution in his property value. The court found that the swimming pool water did not cause the drain to overflow its bank, and that the damage to plaintiff was negligible. The court did not consider defendant's contention that since plaintiff had not complained for eight years, he was estopped from seeking an injunction. Since plaintiff could be adequately compensated by money damages, the court denied the injunction. (Hart-Florida)
W70-10216

QUANTITY AND CHEMICAL QUALITY OF LOW FLOW IN THE PRAIRIE DOG TOWN FORK RED RIVER NEAR WAYSIDE, TEXAS, FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
J. N. Lee, and M. L. Maderak.
Published and distributed by Texas Water Development Board, P. O. Box 12386, Austin, Texas 78711. Texas Water Development Board Report 116, May 1970. 11 p, 2 fig, 3 tab.

Descriptors: *Low flow, *Water quality, *Discharge (Water), *Solutes, *Texas, Streamflow, Chlorides, Saline water, Water chemistry, Texas.
Identifiers: Prairie Dog Town Fork Red River (Texas).

During the period February 6-9, 1968, water discharge in the Prairie Dog Town Fork Red River increased, in a downstream direction, from 0.19 cfs at a point 1 mile below Lake Tanglewood (site 1) to 2.11 cfs near Wayside, Texas (site 69), a river distance of 40.2 miles. Five reaches had significant gains, four had significant losses, three reaches had no flow, and numerous reaches had smaller gains and losses between individual sites. There were no releases from Lake Tanglewood during this period. The quality of water deteriorated progressively downstream. Dissolved solids increased from 468 mg/liter at site 1 to 8,330 mg/liter at site 69. The chloride concentration increased from 28 mg/liter to 3,300 mg/liter. (Knapp-USGS)
W70-10229

TIME OF TRAVEL OF TRANSLATORY WAVES ON THE BRAZOS, LEON, AND LITTLE RIVERS, TEXAS,
Geological Survey, Austin, Tex.
Willard B. Mills.
Published and distributed by Texas Water Development Board, P. O. Box 12386, Austin, Texas 78711. Texas Water Development Board Report 115, April 1970. 14 p, 11 fig, 4 tab, 6 ref.

Descriptors: *Streamflow, *Flood routing, *Hydrographs, Texas, Recession curves, River forecasting, Runoff, Hydrography analysis, Water level fluctuations, Water levels.
Identifiers: Flood waves, Brazos River, Leon River, Little River (Texas).

Travel times of peaks for the 346.4-mile reach of the Brazos River between Whitney and Richmond varied from 213 hours at 1,000 cfs, to 92 hours at 40,000 cfs, to 168 hours at 100,000 cfs. Minimum travel time of peaks for the 82-mile reach between Leon River near Belton and Little River at Cameron varied from 57 hours for initial flow less than 15 cfs at Belton to 42 hours for initial flow above 200 cfs at Belton. Minimum travel time of peaks for the 65-mile reach between Little River at Cameron to Brazos River near Bryan varied from 30 hours for 1,000 cfs, to 22 hours for 3,500 cfs, to 25 hours for 65,000 cfs, to 34 hours for 134,000 cfs. Travel time was not consistent for any discharge, and was even more inconsistent in the low discharge range. Minimum peak travel time for each channel condition was fairly well defined. (Knapp-USGS)
W70-10230

BASE-FLOW RECESSION CHARACTERISTICS AND SEASONAL LOW-FLOW FREQUENCY CHARACTERISTICS FOR MISSOURI STREAMS,
Geological Survey, Rolla, Mo.
John Skelton.
Missouri Geological Survey and Water Resources, Water Resources Report 25, July 1970. 43 p, 5 fig, 9 ref, 2 append.

Descriptors: *Base flow, *Recession curves, *Frequency analysis, *Missouri, Streamflow forecasting, Water utilization, Duration curves, Depth-area-duration analysis.
Identifiers: Low-flow frequency (Missouri).

This report presents the results of a hydrograph analysis of base-flow recessions and a statistical study of seasonal low-flow information for Missouri streams. Base-flow recession characteristics of 116 continuous and partial-record stations and seasonal low-flow frequency information for 215 continuous and partial-record stations are presented. Base-flow recession characteristics for the growing season (May through October) were determined for average and maximum depletion rates from gaging station hydrographs. Points of transition between storm and base-flow recessions, as determined by the intersection of trend lines through storm and base-flow recession data ranged from 50to 90-percent duration on station flow-duration curves. Seasonal low-flow frequency information was computed from annual June through August minimums to provide low-flow frequency data for the irrigation season. The average ratio of seasonal to annual low-flow frequency events for the 7-day period is about 1.5:1 for the Springfield Plateau, 2.1:1 for the Southeastern Lowlands, 3.2:1 for the Till and Osage Plains, and 1.1:1 for the Salem Plateau. (Knapp-USGS)
W70-10235

THE HYDROLOGY OF FOUR STREAMS IN WESTERN WASHINGTON AS RELATED TO SEVERAL PACIFIC SALMON SPECIES,
Geological Survey, Tacoma, Wash.
M. R. Collings, Ronald W. Smith, and G. T. Higgins.
US Geological Survey Open-file Report 1970. 158 p, 75 fig, 16 tab, 14 ref.

Descriptors: *Streamflow, *Salmon, *Spawning, *Fish conservation, *Washington, Water conservation, Anadromous fish, Commercial fishing, Sport fishing, Aquatic habitats, Environment, Ecology.
Identifiers: Salmon conservation.

Enhancement or even preservation of the Pacific Salmon hinges on the careful planning and proper management of the streamflow upon which they depend for spawning purposes. A method of determining preferred spawning conditions and the results of the investigation of 129 measurements on 14 study reaches of the Dewatto, Cedar, Kalama, and North Fork Nooksack Rivers are presented. Water depth and velocities were measured to designate, from area- (spawnable) discharge curves, peak preferred spawning flows for fall chinook, spring chinook, sockeye, and coho salmon at each reach on each river. Also, streambed gravels, water temperature, suspended sediment, dissolved oxygen, and specific conductance are used to help evaluate river conditions during spawning. Peak spawning discharges ranged, for the four salmon species on each of the three study reaches of each river, from 50 to 140 cfs (cubic feet per second) on Dewatto River, from 230 to 510 cfs on Cedar River, from 245 to 800 cfs on Kalama River, and from 195 to 710 cfs on North Fork Noosack River. (Knapp-USGS)
W70-10240

ESTIMATED MEAN-ANNUAL RUNOFF AT POST HEADQUARTERS AREA, WHITE SANDS MISSILE RANGE, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
Arthur G. Scott.
US Geological Survey Open-file report, July 1970. 13 p, 3 fig.

Descriptors: *Runoff, *Stream gages, *New Mexico, *Regression analysis, Statistical methods, Water yield, Rainfall-runoff relationships, Water resources development, Water supply.
Identifiers: White Sands Missile Range (N Mex).

Three different methods of estimating long-term mean-annual runoff were tried in the White Sands Missile Range Headquarters area. Two were considered unsuccessful--a channel geometry method, and a precipitation-altitude relation. Calculations of runoff based on the graphical regression of annual precipitation against annual runoff results in the best estimate possible with the data available. Mean-annual runoff in the drainage area of about 81 square miles is about 69 acre-feet. The standard error for this calculation, based on eight station-years of record, is about 12 percent. An additional error is introduced by projecting data from gaged sites to ungaged sites. The estimated mean-annual runoff value can be better defined and the error reduced by gaging other sites in the Post Headquarters area and by the use of longer periods of record. (Knapp-USGS)
W70-10241

WATER RESOURCES OF THE REDWOOD RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
W. A. Van Voast, L. A. Jerabek, and R. P. Novitzki.
For sale by US Geological Survey, Washington, DC. Price $1.75 per set. US Geological Survey Hydrologic Investigations Atlas HA-345, 3 sheets, 1970. Text, 35 fig, 5 tab, 8 ref.

Descriptors: *Water resources, *Minnesota, Surface waters, Groundwater, Water quality, Recreation, Municipal water, Irrigation water, Water resources development, Lakes, Streamflow, Floods, Aquifers.
Identifiers: Redwood River (Minn).

The water resources of the Redwood River watershed, Minnesota are described in a 3-sheet hydrologic atlas consisting of maps, geologic cross sections, block diagrams, graphs, and tables. Total water use in the watershed is less than 5 percent of the average flow of the Redwood River at Redwood Falls. Over 90 percent of the withdrawals are from groundwater sources. There is good potential for developing both ground- and surface-water sources to meet several times the current demands. Municipal supplies in the watershed are from groundwater. Most municipalities would have little trouble increasing supplies by drilling additional wells. However, water is hard to very hard and generally exceeds the recommended limits for iron and manganese. The suitability of water from a particular source depends upon the intended use. Factors contributing to the desirability of certain waters include the quantity available, the accessibility of the source, and the physical and chemical characteristics of the water. (Knapp-USGS)
W70-10253

HYDROLOGIC RECONNAISSANCE OF THE TANANA BASIN, CENTRAL ALASKA,
Geological Survey, Washington, D.C.
G. S. Anderson.
For sale by U S Geological Survey, Washington, D C - Price $2.00 per set. U S Geological Survey Hydrologic Investigations Atlas HA-319, 4 sheets, 1970. Text, 20 fig, 4 map, 7 tab, 46 ref.

Descriptors: *Hydrogeology, *Water resources, *Alaska, Permafrost, Groundwater, Surface waters, Streamflow, Aquifers, Water yield, Water resources development, Glaciers, Freezing, Runoff, Discharge (Water), Water quality.
Identifiers: Tanana Basin (Alaska).

The Tanana basin in interior Alaska covers approximately 44,500 square miles with 576 square miles of its headwaters in Canada. This report is intended to define in broad terms the hydrology of the Tanana basin. Although basic data are limited, sufficient information is available to formulate a framework for further collection of basic data, preliminary development planning, and identification of problems. The Tanana basin is entirely within the discontinuous permafrost zone of Alaska. Groundwater in the Tanana basin occurs under unconfined and artesian conditions. Unconfined groundwater generally is found in unconsolidated alluvium in the valleys and in fractured bedrock beneath high slopes and ridges. Artesian conditions generally occur in the lower slopes where permeable beds are confined by permafrost or by impermeable sedimentary beds. Along the lower hillslopes, flowing artesian wells are common. The thermal effects of water exert a dominant control on the permafrost regimen. Deeper lakes and rivers and the circulation of groundwater cause the degradation of permafrost and limit its distribution both vertically and areally. The average streamflow of the Tanana River near its mouth is estimated as 37,000 cfs. Approximately 85% of this discharge originates in the Alaska Range; approximately 50% of the discharge is contributed by 4 tributaries from the south side, the Kantishna, Nenana, Nabesna, and Delta Rivers. (Knapp-USGS)
W70-10254

BOUNDARY SHEAR STRESS IN RIVERS AND ESTUARIES,
Washington Univ., Seattle. Dept. of Civil Engineering.
Ronald E. Nece, and J. Dungan Smith.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW 2, Paper 7280, p 335-358, May 1970. 36 p, 13 fig, 1 tab, 18 ref. 2 append. USAEC Contract AT (45-1)-1752.

Descriptors: *Shear drag, *Boundary process*Rivers, *Estuaries, *Current meters, Open channel flow, Instrumentation, Shear, Turbulent flo Velocity.
Identifiers: Boundary shear stress, Preston tubes.

A Preston tube and an array of miniature curre meters for use in rivers and estuaries are describe Procedures are presented for making a Prest tube determination of boundary shear stress hydraulically smooth, transitional, and rough su faces in such natural waterways. Limited fie results available appear to substantiate the metho (Knapp-USGS)
W70-10257

AN ASSESSMENT OF THE WAVE AGITATIO IN THE SMALL BOAT BASIN AT TH CANADA CENTRE FOR INLAND WATERS,
Department of Energy, Mines and Resources, O tawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02H.
W70-10262

MEKONG DELTA MATHEMATICAL MODE PROGRAM CONSTRUCTION,
Bologna Univ. (Italy); and Societe Grenobloisi d'Etude et d'Applications Hydrauliques (France).
For primary bibliographic entry see Field 04A.
W70-10264

USE OF ISOTOPIC DECAY RATES IN TURBU LENT DISPERSION STUDIES,
Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 05B.
W70-10268

CITY OF BIRMINGHAM V NICHOLS (AC CELERATED EROSION OF RAVINE EX CAVATED BY CITY).

1 So 2d 5-6 (Ala 1941).

Descriptors: *Alabama, *Drainage programs, *Set tlement (Structure), *Accelerated erosion, Adjudi cation procedure, Damages, Water injury, Judicia decisions, Legal aspects, Drainage practices, Storm drains, Drainage systems, Excess water (Soils) Riddance (Legal aspects), Surface runoff, Channe improvement, Storm runoff, Bank erosion, Gully erosion, Road damage, Gullies, Flow augmenta tion.

Plaintiff's house and store were bordered by a natu ral ravine which drained the upland. The house an foundation were supported by a retaining wal along the ravine for the length of the house. Defen dant city dredged, deepened and widened the ravine to accelerate water runoff during heavy rain fall. The accelerated onrush of water washed out the foundation of plaintiff's house, causing it to set tle. Plaintiff brought action for damages, alleging in the pleadings that defendant had extended the ravine onto plaintiff's property and removed part of his property. This allegation of trespass was not supported by evidence presented at trial. Other evidence presented at trial, however, corroborated plaintiff's assertion of defendant's negligence in deepening and widening the ditch. In reversing the lower court's decision for plaintiff, the Supreme Court of Alabama held that the trial court had committed reversible error in submitting the un supported allegation of trespass to the jury. The court noted, however, that municipalities have a duty to protect lower proprietors when utilizing natural drains to accelerate runoff of surface water. (Hart-Florida)
W70-10288

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION 1966-1968, UNITED STATES AND CANADA.
Water Resources Council, Washington, D.C.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C, 20402 - Price $5.25. Water Resources Council, Joint Hydrology-Sedimentation Committees Bulletin 10, July 1970. 613 p.

Descriptors: *Bibliographies, *Abstracts, *Hydrology, *Sedimentation, Water resources, Water chemistry, Water quality, Groundwater, Surface waters, Hydrogeology, Water utilization, Snow, Runoff, Meteorology, Flow, Floods, Forests, Hydrologic budget.

This bibliography of over 7,000 references is a guide to literature on hydrology and sedimentation for the use of Government agencies and the public. Efforts were made to cover all such literature published in the United States and Canada during 1966-1968. The index of the bibliography covers both place and subject. In the United States and Canada, the smallest geographical subdivisions used are states and provinces. Elsewhere, geographical subdivision is by country. For papers applying to areas larger than the smallest subdivision, entries are listed under major river basins in the United States and by continents for the rest of the world. Secondary listings have been used where a paper is of a scope clearly exceeding the one subject listing. (Knapp-USGS)
W70-10318

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65 - PART 9. COLORADO RIVER BASIN, VOLUME 1. COLORADO RIVER BASIN ABOVE GREEN RIVER.
Geological Survey, Washington, D.C.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402. U S Geological Survey Water-Supply Paper 1924, 1970. 488 p, 1 fig, 1 plate.

Descriptors: *Surface waters, *Streamflow, *Flow measurement, *Gaging stations, Flow rates, Average flow, Low flow, Lakes, Reservoir stages.
Identifiers: *Colorado River basin, *Basic data, Stream discharge, Flow extremes, Crest stage.

This volume, Surface Water Supply of the Colorado River Basin Above Green River, is one of a series of 37 reports presenting records of stage, discharge, and content of streams, lakes, and reservoirs in the United States during the 1961-65 water years. The data reported comprise a description of the gaging station, and tables showing the daily, monthly, and yearly discharges of the stream. The description of the station gives the location drainage area, records available, type and history of gage, average discharge, extremes of discharge, and general remarks. For most gaging stations on lakes and reservoirs the data presented comprise a description of the station and a monthly summary table of stage and contents. Data for partial-record stations are presented in two tables. The first is a table of discharge measurements at low-flow partial-record stations, and the second is a table of annual maximum stage and discharge at crest-stage stations. (See also W70-10320) (Woodard-USGS)
W70-10319

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65 - PART 8. WESTERN GULF OF MEXICO BASINS, VOLUME 2. BASINS FROM LAVACA RIVER TO RIO GRANDE.
Geological Survey, Washington, D.C.

For sale by Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $4.00. U S Geological Survey Water-Supply Paper 1923, 1970. 786 p, 1 fig, 1 plate.

Descriptors: *Surface waters, *Streamflow, *Flow measurement, *Gaging stations, Flow rates, Average flow, Low flow, Lakes, Reservoir stages.
Identifiers: *Western Gulf of Mexico Basins, Basic data, Stream discharge, Flow extremes, Crest stage.

This volume, Surface Water Supply of Western Gulf of Mexico Basins, Lavaca River to Rio Grande, is one of a series of 37 reports presenting records of stage, discharge, and content of streams, lakes, and reservoirs in the United States during the 1961-65 water years. The data reported comprise a description of the gaging station, and tables showing the daily, monthly, and yearly discharges of the stream. The description of the station gives the location drainage area, records available, type and history of gage, average discharge, extremes of discharge, and general remarks. For most gaging stations on lakes and reservoirs the data presented comprise a description of the station and a monthly summary table of stage and contents. Data for partial-record stations are presented in two tables. The first is a table of discharge measurements at low-flow partial-record stations, and the second is a table of annual maximum stage and discharge at crest-stage stations. (See also W70-10319) (Woodard-USGS)
W70-10320

LAND CAPABILITY: A HYDROLOGIC RESPONSE UNIT IN AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
Charles B. England.
USDA-ARS 41-172, Sept 1970. 12 p, 4 tab, 1 illus, 18 ref.

Descriptors: *Streamflow, *Runoff, *Watersheds (Basins), *Hydrologic properties.
Identifiers: Ralston Creek, Iowa, land capability classes, hydrologic soil grouping.

Understanding the hydrology of agricultural watersheds requires a knowledge of the spatial distribution of runoff-contributing and runoff-absorbing areas and their relation to each other. Soil surveys, interpreted into land-capability groupings, can provide a tool for assessing spatial distribution, and thus appear to offer promise as a serviceable and, fortunately, already established hydrologic soil grouping. Land-capability classes are based on the same soil-landform criteria as those used in hydrologic soil groupings: surface moisture capacities and position on the landscape. In addition, land-capability classes are intuitively unique in land use and provide a basis for futuristic estimates of land use as well as hydrologic performance. This concept is exploratory and is offered here as an inducement for discussion and, hopefully, further testing. (England-USDA-ARS)
W70-10407

FOLKLORE AND BROMIDES IN WATERSHED MANAGEMENT.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-10410

NICHOLS V CITY OF MORRISTOWN (LIABILITY FOR INJURY DUE TO INADEQUACY OF CREEK TO ACCOMMODATE SURFACE WATER).

263 NW 900-901 (Minn 1935).

Descriptors: *Minnesota, *Surface drainage, *Rainfall-runoff relationships, *Overflow, Cities, Tiles, Tile drains, Tile drainage, Surface waters, Surface runoff, Creeks, Outlets, Rain, Rainfall, Snowmelt, Judicial decisions, Legal aspects, Damages, Remedies.

Plaintiff sought damages for injury to his property caused by the overflow of a creek. Plaintiff contended the overflow was due to the negligent laying of drainage tile by defendant city. Defendant contended the overflow was caused by the fact that the creek could not accommodate the surface water that was produced by melting snow and heavy rains. Based on the testimony and other evidence of record, the court ruled that plaintiff had no cause of action due to any negligent or improper conduct on defendant's part. The judgment for defendant was affirmed. (Price-Florida)
W70-10483

2F. Groundwater

MODEL STUDIES OF TIDAL EFFECTS ON GROUNDWATER HYDRAULICS,
Hawaii Univ., Honolulu. Water Resources Research Center.
John A. Williams, Ronald N. Wada, and Ru-yih Wang.
Available from NTIS as PB-194 353, $3.00 in paper copy, $0.65 in microfiche. Hawaii University Water Resources Research Center Technical Report No 39, May 1970. 80 p, 21 fig, 4 tab, 4 append. OWRR Project A-015-HI (1).

Descriptors: *Tidal effects, *Water level fluctuations, *Model studies, *Groundwater, Groundwater movement, Porous media, Computer programs, Mathematical models, Analog models, Hydraulic models.
Identifiers: Groundwater-tidal relationships.

A model study was made of the propagation of periodic fluctuations in the piezometric head through a saturated porous media. Three different models were employed: a hydraulic model, a mathematical model, and an electrical analog model. The hydraulic model consisted of one or more layers of polyurethene foam placed in a lucite tank. The foam was tested in a confined and unconfined condition using both a no-flow and a constant-head boundary condition at the internal boundary. The mathematical and electric analog models duplicated the conditions in the hydraulic model. The diffusion theory can describe the propagation of such distrubances provided that the boundary conditions are satisfied and that the correct diffusion coefficient is employed. The calculation of the correct diffusion coefficient requires that an appropriate storage coefficient and an apparent porosity be used for the confined and unconfined models, respectively. For the unconfined case, the ratio of the apparent porosity to the true porosity is of the same order of magnitude for both the polyurethene foam and a Sacramento River sand. (Knapp-USGS)
W70-10034

OPTIMAL PLANNING OF A COASTAL COLLECTOR,
Technion-Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel-aviv.
M. Shechter, and J. Schwarz.
Research supported by grants from US Dept of Agriculture and TAHAL, Water Planning for Israel. Water Resources Research, Vol 6, No 4, p 1017-1024, August 1970. 8 p, 3 fig, 3 tab, 8 ref.

Descriptors: *Water resources development, *Water yield, *Mathematical models, *Optimization, Water levels, Pumping, Withdrawal, Groundwater movement, Saline water-freshwater interfaces, Saline water intrusion, Hydrogeology.
Identifiers: *Well fields, Israel, Coastal aquifers.

The optimal design of a collector using seaward groundwater flow in a coastal aquifer is obtained by analyzing the interrelated hydrologic, engineering, and economic aspects of the project. The optimal size of the project determines the pumping rate and the pumping policy, as well as the location of the wells in relation to the coast. A model of the relevant hydrologic relationships in the aquifer uses a criterion for economically efficient utilization of the aquifer, estimates the model parameters, and determines an optimal project size. (Knapp-USGS)
W70-10053

APPLICATION OF THE CONVOLUTION RELATION TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,
Arizona Univ., Tucson. Hydrology and Water Resources.
For primary bibliographic entry see Field 02A.
W70-10067

GROUNDWATER LEVELS IN NEBRASKA,
Geological Survey, Lincoln, Nebr.
For primary bibliographic entry see Field 04B.
W70-10071

GENERAL HYDROLOGY OF THE MIDDLE GULF AREA, FLORIDA,
Geological Survey, Tallahassee, Fla.
R. N. Cherry, J. W. Stewart, and J. A. Mann.
Florida Bureau of Geology Report of Investigation No 56, Department of Natural Resources, 1970. 96 p, 45 fig, 4 tab, 34 ref.

Descriptors: *Hydrogeology, *Water resources, *Florida, Hydrologic budget, Groundwater, Surface waters, Springs, Groundwater movement, Streamflow, Aquifers, Water supply, Water utilization.
Identifiers: Middle Gulf Area (Fla).

The Middle Gulf area in the west-central coast of peninsular Florida encompasses about 1,700 sq mi. The area is drained principally by the Crystal, Homosassa, Chassahowitzka, Weekiwachee, Pithlachascotee and Anclote Rivers and Cypress Creek. The average daily discharge from thearea for the period January 1964-June 1966, was 2,300 cfs. No permanent regional declines in surface or groundwater levels have occurred in the area. Principal outflow from the hydrologic system is evapotranspiration which amounts to about 67% of the total outflow. Runoff amounts to about 32% and direct groundwater outflow to the sea is about 1%. Rainfall averages about 55 inches annually. Eighty percent of the runoff from the area originates either as spiringflow or seepage to streams from the Floridan aquifer. The water-level gradients in the system are about the same as the topographic gradients (2-3 ft/mi). Water levels are highest in late summer or early fall following the rainy season and are lowest in late May or early June. The chemical quality of ground and surface water is good. Ample supplies of good quality water are available for existing and foreseeable uses. (Knapp-USGS)
W70-10073

INTERFERENCE BETWEEN GRAVITY WELLS STEADY STATE FLOW,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
Abdel-Aziz I. Kashef.
Water Resources Bulletin, Vol 6, No 4, p 617-630, July-August 1970. 14 p, 2 fig, 1 tab, 12 ref.

Descriptors: *Groundwater movement, *Drawdown, *Water level fluctuations, *Steady flow, Dupuit-Forchheimer theory, Mathematical studies, Water table, Porous media, Well spacing.
Identifiers: Well interference.

Under steady state conditions of flow, seepage toward a single gravity well is governed by the Laplace Equation, which may be written in terms of either the hydraulic head, the pressure head, or the velocity potential. Although this equation is linear, the principle of superposition cannot be applied to sum up the individual effects in the case of a multiple gravity well system because of the variation of the flow domain under the effect of one or several wells. A method is presented allowing the use of the superposition principle in a restricted form. Decrements of the base pressure heads are superposed on initial heads before pumping. Decrements in the areas of the pressure head diagrams across specific vertical sections can be summed up. (Knapp-USGS)
W70-10076

HOW MUCH UNDERGROUND WATER STORAGE CAPACITY DOES TEXAS HAVE,
Texas Water Development Board, Austin. Groundwater Div.
For primary bibliographic entry see Field 04B.
W70-10081

SALINE GROUNDWATER RESOURCES OF THE RIO GRANDE DRAINAGE BASIN--A PILOT STUDY.
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 03A.
W70-10086

INVESTIGATION OF GROUNDWATER FLOW WITH RADIOCARBON,
Groningen Rijksuniversiteit (Netherlands).
J. C. Vogel.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/24, p 355-369, 1967. 15 p, 7 fig, 5 tab, 2 ref.

Descriptors: *Groundwater movement, *Radioactive dating, *Carbon radioisotopes, Flow velocity, Recharge, Aquifers, Surface-groundwater relationships, Tracers, Tracking techniques, Stable isotopes, Radioisotopes, Radioactivity techniques.
Identifiers: Netherlands.

Radiocarbon dating of groundwater may be used for deduction of recharge rates of aquifers. The relationships between the age at a point in the water-body and the recharge depends on whether the aquifer is confined or unconfined. For an unconfined aquifer receiving recharge over the whole surface area a simple relationship is deduced. Such an aquifer can be characterized by its age at half-depth. Natural radiocarbon has been used to study flow patterns and flow-rates of subterranean waterbodies in the Netherlands. The deep groundwater in the south-east region of the Usselmeer presents a complicated situation caused by the inhomogeneity of the strata. Flow-rates are therefore not so readily deduced, but the different aquifers can be distinguished by using the isotopes C-14, C-13 and O-18 as natural tracers. In the province of Friesland the deep groundwater shows a more consistent picture with flow times of several thousand years corresponding to quite acceptable flow-rate of around 10 m/yr. (Knapp-USGS)
W70-10092

NATURAL TRITIUM IN GROUNDWATER STUDIES,
Iceland Univ., Reykjavik.
P. Theodorsson.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/26, p 371-380, 1967. 10 p, 7 fig, 1 tab, 6 ref.

Descriptors: *Water chemistry, *Tritium, *Fallout, Radioisotopes, Groundwater movement, Tracers, Tracking techniques, Water analysis, Thermal springs, Thermal water.
Identifiers: Iceland.

Since 1952 large quantities of tritium have been injected into the atmosphere from tests with thermonuclear weapons and large variations in the tritium concentrations of rain have occurred. These variations are reflected in groundwater in different ways depending on the history of the water. Therefore, tritium measurements can give valuable information about groundwater dydrology. Rain, river water, groundwater and geothermal water from various localities in Iceland have been sampled since 1960, and routine measurements of tritium have been carried out since 1963. The paper reports the tritium concentration of thermal water from major geothermal areas in Iceland together with some measurements on other groundwater systems. (Knapp-USGS)
W70-10093

TRITIUM HYDROLOGY IN NEW ZEALAND,
Department of Scientific and Industrial Researc
Lower Hutt (New Zealand). Div. of Nuclea
Sciences.
T. L. Grant-Taylor, and C. B. Taylor.
In: Isotopes in Hydrology, Proceedings Symposiu
of International Atomic Energy Agency and Int
national Union Geodesy and Geophysics, Vienn
Nov 14-18, 1966: International Atomic Ener
Agency STI/PUB/141, Vienna, Paper No SM
83/27, p 381-400, 1967. 20 p, 7 fig, 8 tab, 33 ref.

Descriptors: *Tritium, *Groundwater movemen
*Tracers, Radioactivity techniques, Radioisotop
Tracking techniques, Fallout, Recharge, Aquife
Groundwater basins.
Identifiers: New Zealand.

Knowledge gained from the study of post-the
monuclear concentrations of THO in New Zeala
rainwaters has been applied to the interpretation
the measured concentrations in a number of u
derground and surface waters. The Heretaun
Plains artesian system is particularly simple.
geometry allows mathematical expressions to
derived relating the tritium concentrations in we
tapping the main, shallowest aquifer to t
distances of these wells from the aquifer input,
terms of the various aquifer parameters. In the Hu
Valley system, comparison of the concentrations
river and artesian water over a period of some yea
allows an exact determination of aquifer travel tim
to the main withdrawal point. Measuremen
which are in good agreement with geologic
evidence, are reported for waters taken from d
ferent levels of a test bore penetrating the differe
strata of the system. (Knapp-USGS)
W70-10094

TRITIUM AND HYDROGEOLOGY-IN
VESTIGATIONS AND MEASUREMENTS CA
RIED OUT AT THE GRENOBLE NUCLEA
RESEARCH CENTER (FRENCH),
Commissariat a l'Energie Atomique, Grenob
(France). Centre d'Etudes Nucleares.
For primary bibliographic entry see Field 07A.
W70-10097

SEASONAL VARIATIONS IN THE TRITIU
CONTENT OF GROUNDWATERS OF TH
VIENNA BASIN, AUSTRIA,
International Atomic Energy Agency, Vienn
(Austria).
G. H. Davis, B. R. Payne, T. Dincer, T. Florkowski
and T. Gattinger.
In: Isotopes in Hydrology, Proceedings Symposiu
of International Atomic Energy Agency and Inte
national Union Geodesy and Geophysics, Vienna
Nov 14-18, 1966: International Atomic Energ
Agency STI/PUB/141, Vienna, Paper No SM
83/32, p 451-473, 1967. 23 p, 9 fig, 1 tab, 11 ref.

Descriptors: *Tritium, *Groundwater movemen
*Recharge, *Tracers, *Tracking techniques
Groundwater basins, Radioisotopes, Radioactivit
techniques, Precipitation (Atmospheric), Fallout.
Identifiers: Vienna Basin (Austria).

Monthly analyses of tritium from 22 sources o
groundwater of the Vienna Basin have been mad
since April 1965 with a view to elucidating th
complex groundwater-surface water relations an
ascertaining the movement of groundwaters. Th
sources are classified broadly into four groups: (1
Nonthermal springs including karst springs of th
bordering mountains; (2) thermal springs risin
along faults that border the floor of the Vienna
Basin; (3) wells on the floor of the Basin; and (4
large groundwater overflows on the floor of the
Basin. All groundwater sampled showed the effec
of local recharge by high tritium precipitation in
the exceptionally wet summer of 1965. Ground
water overflows thought to represent discharge
from the main groundwater reservoir were
generally higher in tritium than other groundwaters

ndicating rapid shallow circulation from nearby streams. Thermal springs believed representative of deep circulation all showed the effect of mixing with shallow waters recharged from current precipitation. The highest tritium contents in well waters were from the upper part of the Basin where water levels are very deep and streams lose water in crossing the alluvium. Samples taken during drilling of a deep exploratory well show a decrease in tritium with depth, but even at 140 m depth the tritium content was 13 T. U. indicating relatively rapid circulation throughout the principal aquifer. (Knapp-USGS)
W70-10098

THE APPLICATION OF RADIATION LOGS TO GROUNDWATER HYDROLOGY,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07B.
W70-10099

RADIOISOTOPE TRACERS IN LARGE-SCALE RECHARGE STUDIES OF GROUNDWATER,
Water Planning for Israel Ltd., Tel Aviv (Israel); and Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 07B.
W70-10100

SINGLE-WELL PULSE TECHNIQUE,
Geological Inst., Warsaw (Poland); Federal Experimental and Research Inst., Vienna (Austria); and Institute of Nuclear Research, Krakow (Poland).
For primary bibliographic entry see Field 07B.
W70-10101

INVESTIGATIONS INTO GROUNDWATER BALANCE BY APPLYING RADIOISOTOPE TRACERS,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 07B.
W70-10102

BOREHOLE DILUTION TECHNIQUES: A CRITICAL REVIEW,
International Atomic Energy Agency, Vienna (Austria); Federal Experimental and Research Inst., Vienna (Austria); and Institute of Nuclear Research, Kracow (Poland).
For primary bibliographic entry see Field 07B.
W70-10103

LABORATORY EVALUATION OF Cr-51 EDTA AS A TRACER FOR GROUNDWATER FLOW,
Chalmers Univ. of Technology, Goteborg (Sweden); and Ingeniors Vetenskaps Akademien, Stockholm (Sweden).
For primary bibliographic entry see Field 07B.
W70-10106

APPLICATION OF THE INTEGRATION METHOD TO THE DETECTION OF WATER-BORNE Cr-51-EDTA AND RADON ON ACTIVATED CARBON (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
For primary bibliographic entry see Field 07B.
W70-10107

FUNDAMENTALS OF THE DISPERSION OF RADIONUCLIDES IN SANDY AQUIFERS,
Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium).
L. H. Baetsle, and J. Souffriau.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/41, p 617-628, 1967. 12 p, 4 tab, 8 ref.

Descriptors: *Tracers, *Tracking techniques, *Groundwater movement, *Hydrogeology, Aquifers, Sands, Sandstones, Instrumentation, Data processing, Dispersion, Diffusion, Mixing, Velocity, Adsorption.
Identifiers: Tracer dispersion.

Design principles for injections of radioactive trace substances into homogeneous aquifers are outlined. If the radiotracer is not absorbed by the solid phase the pulse shape has a symmetric form that may be described mathematically by the classical diffusion equations. The magnitude of the dispersion coefficients and their determination are discussed in detail. The leading and trailing parts of the distribution curve may be considered as forming part of two different normal distributions with two dispersion coefficients. An example of this approach is out in detail. The asymmetric pulse-shape can be described analytically as a homogeneous concentration/distribution curve, but the computation method is very complicated. Some limitations of this approach are discussed from the fundamental as well as from the computation point of view. (Knapp-USGS)
W70-10109

THE STORAGE COEFFICIENT AS A FUNCTION OF WATER TABLE CELERITY,
Washington State Univ., Pullman. Dept. of Civil Engineering.
David T. Higgins, and Cheng-Nan Lin.
Available from NTIS as PB-194 458, $3.00 in paper copy, $0.65 in microfiche. Completion Report, August 1970. 41 p, 14 fig, 4 tab, 10 ref, 4 append. OWRR Project A-029-WASH (1).

Descriptors: *Storage coefficient, Specific yield, Unsteady flow, Transient flow, *Drainage, *Drawdown, *Water table.

Many analyses of unsteady water table drawdown lead to inaccurate results near the outflow face at early time. They suffer from the assumption that the yield of drainable water is immediate and complete, as is that of confined aquifers. That assumption is true only for slow rates of drawdown. For rapid drawdown a better assumption is required. It is hypothesized that the rate of gravity drainage varies inversely with the rate of water table drawdown. The hypothesis was disproved in tests of vertical sand column drainage. Over the range of variables tested the drainage increased with water table celerity and showed multiple values. The parameter was the rate of pressure drop at the column base. A computer simulation of the problem was devised which closely reproduced the experimental results. Another approach to the problem was taken. For a given rate of change of base pressure the column drainage approaches an asymptotic value. Normalized asymptotic drainage-pressure drop data for several sand sizes plotted as a single curve. A simple exponential equation approaches that function. A modification of this equation is proposed which is based on the similarities between stream tubes in aquifers and the vertical sand column. It is recommended that application of the modification to multidimensional drawdown problems be pursued.
W70-10119

SOUTHERN MARYLAND RECORDS OF SELECTED WELLS, WATER LEVELS, AND CHEMICAL ANALYSES OF WATER,
Geological Survey, Towson, Md.
For primary bibliographic entry see Field 04B.
W70-10231

HYDROGEOLOGIC DATA FOR THE LOWER HOUSATONIC RIVER BASIN, CONNECTICUT,
Geological Survey, Hartford, Conn.
For primary bibliographic entry see Field 04B.
W70-10233

HYDROLOGIC CONDITIONS AND ARTIFICIAL RECHARGE THROUGH A WELL IN THE SALEM HEIGHTS AREA OF SALEM, OREGON,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 04B.
W70-10236

WATER RESOURCES AT MARINE CORPS SUPPLY CENTER, BARSTOW, CALIFORNIA FOR THE 1969 FISCAL YEAR,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-10237

A DIGITAL MODEL FOR AQUIFER EVALUATION,
Geological Survey, Washington, D.C.
George F. Pinder.
For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price 35 cents. US Geological Survey Techniques of Water-Resources Investigations, Book 7, Chapter C1, 1970. 18 p, 4 fig, 1 tab, 3 ref.

Descriptors: *Computer programs, *Drawdown, *Aquifers, Data processing, Water level fluctuations, Water levels, Water wells, Withdrawal, Surveys, Testing, Simulation analysis, Synthetic hydrology, Transmissivity, Storage coefficient.
Identifiers: Aquifer evaluation.

A digital computer program simulates the response of a confined aquifer to pumping at a constant rate from one or more wells. The groundwater reservoir may be irregular in shape and nonhomogeneous with infiltration from one or more lakes and streams. The program is written in FORTRAN IV for the IBM 360 system. (Knapp-USGS)
W70-10238

WATER RESOURCES OF NORTHEAST FLORIDA (ST. JOHNS RIVER BASIN AND ADJACENT COASTAL AREAS),
Geological Survey, Tallahassee, Fla.
L. J. Snell, and Warren Anderson.
Florida Bureau of Geology Report of Investigation No 54, Department of Natural Resources, 1970. 77 p, 34 fig, 9 tab, 21 ref.

Descriptors: *Groundwater, *Florida, *Hydrogeology, Water resources, Water resources development, Aquifers, Water wells, Artesian wells, Water levels, Data collections, Hydrologic data.
Identifiers: Groundwater resources, St. Johns River basin (Fla).

This report summarizes and appraises the water resources of the St. Johns River basin and the adjacent narrow coastal strip of northeast Florida. The area contains about 11,200 square miles and has about one-quarter of Florida's population. The report provides information on the occurrence, availability, chemical quality, and use of surface and underground waters as a guide for public and private agencies for planning the most beneficial development of the water resources of the area, to recognize areas of excess and deficient water, areas of good and poor quality waters, and areas where further detailed investigations are desirable. Population growth and economic expansion create the need for additional water supplies either from present sources or from new sources. Ample quantities of good quality water are available to meet foreseeable water needs. Water withdrawn from surface and groundwater sources is less than 10 percent, and that consumed is less than 5 percent of the estimated available supply exclusive of saline waters used for cooling in electric power generation. Most sources of readily available good quality water are in the western parts of the report area and the centers of greatest demand are along the Atlantic coast. (Grossman-USGS)
W70-10239

THEORY OF DISPERSION IN A GRANULAR MEDIUM,
Geological Survey, Washington, D.C.
Akio Ogata.
For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price 45 cents. US Geological Survey Professional Paper 411-I, 1970. 34 p, 21 fig, 53 ref.

Descriptors: *Dispersion, *Porous media, Groundwater movement, Water chemistry, Path of pollutants, Adsorption, Mathematical studies, Saline water-freshwater interfaces, Saline water intrusion, Equations, Diffusion, Mass transfer, Mixing.
Identifiers: Dispersion in granular media.

Theoretical aspects of investigations and a few confirmatory laboratory studies of the dispersion process are discussed. The basic assumptions associated with the development of the dispersion equation, based on the applicability of a heuristic expression similar to Fick's law, are described. In general, these assumptions limit its application to a homogeneous medium in which the dispersion process is anisotropic. Several solutions are given for the differential equation that approximates the dispersion process. The equations approximating dispersion in a two-fluid system (salt-fresh water) are also presented. (Knapp-USGS)
W70-10242

EMPIRICAL RELATIONS IN PROPERTIES OF UNCONSOLIDATED QUARTZ SANDS AND SILTS PERTAINING TO WATER FLOW,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia); and Australian Atomic Energy Commission Research Establishment, Lucas Heights.
William A. Wiebenga, W. R. Ellis, and L. Kevi.
Water Resources Research, Vol 6, No 4, p 1154-1161, August 1970. 8 p, 6 fig, 2 tab, 9 ref.

Descriptors: *Groundwater movement, *Dupuit-Forchheimer theory, *Tracers, Hydrogeology, Particle size, Porosity, Radioisotopes, Permeability, Velocity, Flow, Specific yield, Sediments, Aquifers, Laboratory tests, Hydraulic conductivity.
Identifiers: Sorting coefficient.

During a laboratory investigation using radiotracers, empirical formulas were developed to replace the ambiguous or incorrect Dupuit-Forchheimer assumption used in relationships governing the flow of water through porous, unconsolidated materials ranging from clay to coarse sands or fine gravels. The Dupuit-Forchheimer assumption states that the ratio of specific flow rate to average flow velocity is equal to porosity, but it is not specified whether true porosity or void ratio or specific yield, also called effective porosity, is meant. The hydraulic conductivity shows a good correlation with the maximum 10% grain size, and the ratio of specific flow rate to average flow velocity shows good correlation with functions of specific yield and percentile sorting coefficient. From field measurements of specific flow rate and average flow velocity the specific yield can be computed. (Knapp-USGS)
W70-10245

LITHOLOGIC CONTROLS ON THE DEVELOPMENT OF SOLUTION POROSITY IN CARBONATE AQUIFERS,
Pennsylvania State Univ., University Park.
Henry W. Rauch, and William B. White.
Water Resources Research, Vol 6, No 4, p 1175-1192, August 1970. 18 p, 14 fig, 6 tab, 15 ref. OWRR Project A-005-PA.

Descriptors: *Karst, *Pennsylvania, *Porosity, *Water chemistry, *Carbonate rocks, Caves, Geochemistry, Limestones, Dolomite, Drainage effects, Geomorphology, Groundwater movement, Subsurface drainage, Rock properties.
Identifiers: Solution porosity.

Movement of groundwater in maturely karsted limestone aquifers is commonly through solution conduits of considerable size. The volume of all accessible caves more than 100 feet in length in the Nittany Valley area of central Pennsylvania was measured. Most caves are entirely within limestones. Cave development in dolomite is extremely rare. Within the limestone sequence the bulk of the cave volume is concentrated in a few members. Chemical and petrographic analyses of the carbonate rocks were associated with cave volume by bar graphs and components analyses. The more cavernous limestones seem to be those with low amounts of dolomite, clay, and other impurities, and a high micrite grain fraction. Coarse limestones and dolomites are less cavernous. (Knapp-USGS)
W70-10250

GEOLOGY AND GROUNDWATER RESOURCES OF THE GRAND RAPIDS AREA, NORTH-CENTRAL MINNESOTA,
Geological Survey, Washington, D.C.
Edward L. Oakes.
For sale by US Geological Survey, Washington, DC - Price $1.50 per set. US Geological Survey Hydrologic Investigations Atlas HA-322, 2 sheets, 1970. Text, 8 fig, 2 map, 3 tab, 11 ref.

Descriptors: *Water resources, *Hydrogeology, *Minnesota, *Mississippi River basin, Aquifers, Glacial drift, Lakes, Reservoirs, Mississippi River, Water yield, Groundwater movement, Water quality, Permeability, Transmissivity, Geology.
Identifiers: Grand Rapids (Minn).

This 2 sheet Hydrological Atlas is one of a series of studies of geology and groundwater availability conducted in and near selected communities on the Mesabi Iron Range, north-central and northeastern Minnesota. This report describes the geology and groundwater conditions in the 303 square-mile Grand Rapids area. Sheet 1 is designed for use by anyone interested in the geology and occurrence of groundwater in the geologic units of the area. Sheet 2 is designed to be used by hydrologists and engineers who have the responsibility for major groundwater development in the area. The Grand Rapids area is drained by the Mississippi and Prairie Rivers. Pokegama Lake is a reservoir formed by a dam on the Mississippi River. Prairie Lake is formed by a dam on the Prairie River. The area also contains many natural lakes and swamps which provide excellent fish and wildlife habitat. Groundwater supplies may be obtained from glacial drift and from Precambrian metasedimentary (Animikie) rocks. The best source of groundwater is from buried outwash in the glacial drift. Regional groundwater movement is toward the Mississippi and Prairie Rivers. Groundwater may be very hard and high in iron and manganese. (Knapp-USGS)
W70-10252

WATER RESOURCES OF THE REDWOOD RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-10253

HYDROLOGIC RECONNAISSANCE OF THE TANANA BASIN, CENTRAL ALASKA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-10254

GROUNDWATER GEOLOGY OF THE ROCK ISLAND, MONMOUTH, GALESBURG, AND KEWANEE AREA, ILLINOIS,
Illinois State Geological Survey, Urbana.
John E. Brueckmann, and Robert E. Bergstrom.
Illinois Geological Survey Report of Investigations 221, 1968. 56 p, 14 fig, 3 tab, 44 ref, append.

Descriptors: *Hydrogeology, *Illinois, Groundwater, Water resources, Water resources development, Water wells, Aquifers, Water utilization, Groundwater movement, Water yield, Water quality, Data collections, Hydrologic data, Geology, Mississippi River basin.
Identifiers: Rock Island (Ill).

Groundwater in the Rock Island, Monmouth, Galesburg, and Kewanee area, Illinois, is obtained from (1) sand and gravel aquifers within the glacial drift; (2) shallow bedrock aquifers that are primarily dolomite of the Niagaran Series (Silurian) and the Keokuk-Burlington Limestone (Mississippian) and (3) deep bedrock aquifers, primarily the Ordovician Ancell Group (Glenwood-St. Peter Sandstone) and the Cambrian Ironton-Galesville Sandstone. Most private water supplies are obtained from the shallow bedrock aquifers, whereas the larger municipal supplies generally are obtained from the deep bedrock aquifers. Sand and gravel aquifers are sparsely distributed in the area. The estimated total pumpage of groundwater along the 16,531,000 gallons per day for the area. This constitutes about 50% of the estimated total pumpage of both surface and groundwater and serves about 63% of the population. Municipalities now using groundwater can probably develop additional groundwater sources to meet increased demands in the future. (Knapp-USGS)
W70-10284

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION 1966-1969 UNITED STATES AND CANADA.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-10318

2G. Water in Soils

FLOW FROM A SPHERICAL SOURCE WITH WATER CONTENT DEPENDENT DIFFUSIVITY,
San Jose State Coll., Calif.
For primary bibliographic entry see Field 05B.
W70-10058

USE OF THE MASS BALANCE METHOD FOR EXAMINING THE ROLE OF SOILS IN CONTROLLING WATERSHED PERFORMANCE,
Agricultural Research Service, University Park, Northeast Watershed Research Center.
For primary bibliographic entry see Field 02A.
W70-10064

MEASUREMENT OF THE MOLECULAR SIZE OF A SODIUM HUMATE FRACTION,
Geological Survey, Denver, Colo.
R. L. Wershaw, S. J. Heller, and D. J. Pinckney.
Advances in X-Ray Analysis, Vol 13, p 609-61[illegible] 1970. 9 p, 2 fig, 11 ref.

Descriptors: *Humic acids, *X-ray analysis, *Particle size, *Molecular structure, Soil chemistry, Soil physical properties, Soil chemical properties.
Identifiers: Sodium humate, Molecular size.

As a first step in developing a soil humate classification system a fraction of sodium humate from a North Carolina soil was isolated and its molecular size was measured by small angle x-ray scattering. Most of the sodium humate fractions isolated by ion exchange and gel permeation chromatography have distinctly different infrared absorption spectra, which indicates that these fractions differ from one another in either their chemical structure or degree of polymerizations. Size measurements of one of these fractions by small angle x-ray scattering indicates that the fraction is made up either of molecules of two different sizes or of zones of molecules of a single size. (Knapp-USGS)
W70-10074

INVESTIGATIONS INTO GROUNDWATER BALANCE BY APPLYING RADIOISOTOPE TRACERS,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 07B.
W70-10102

SOIL-WATER MOVEMENT AND EVAPOTRANSPIRATION: CHANGES IN THE ISOTOPIC COMPOSITION OF THE WATER,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
For primary bibliographic entry see Field 02K.
W70-10104

LOCALIZATION OF LEAKAGES FROM A LARGE RESERVOIR, USING RADIOACTIVE TRACERS (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
For primary bibliographic entry see Field 07B.
W70-10110

METHODS OF DETERMINATION OF WATER IN MATERIALS OF DIFFERENT STATE OF AGGREGATION (IN RUSSIAN),
Chemico-Technological Inst., Moscow (USSR).
V. A. Drozdov, A. P. Kreshkov, and S. I. Petrov.
Uspekhi Khimii, Vol 38, No 1, p 113-141, 1969. 715 ref.

Descriptors: *Hydrology, *Moisture content, *Aquifers, Hydrologic data, Analysis, Earth-water interfaces, Measurement, Drying, Gas chromotography, Distillation, Sorption, Specific gravity, Cohesion, Conductivity, Chromotography, Absorption, Centrifugation, Radio waves, Nuclear magnetic resonance.
Identifiers: NMR Spectroscopy, Coulombometry, Ultrasonic analyses, Titration, Dielectric penetrability, Gases, Organic liquids, Hydrophotography, Optical properties, Beta and gamma emanations.

This essay reviews most important information pertinent to nearly all methods of water determination in materials of highly diversified origin. The paper is subdivided into 3 sections: (1) Methods based on expelling water (by drying, sorption, or distillation); (2) Methods utilizing chemical reactions (gasometry, titration); (3) Physical and physicochemical methods (determination of specific gravity), cohesion, the rotation angle of polarized light, coefficient of refraction, dielectric penetrability, conductance, amount of absorbed coulombs, optical properties, nuclear magnetic resonance (NMR Spectrography), gases and organic liquids (absorption and gas-liquid chromatography), beta and gamma emanations, ultrasonic values, restoration of film color (hydrophotography), results of centrifuging, and absorption of radio waves. The voluminous list of references, truly international in scope, deserves particular mention. (Wilde-Wisconsin)
W70-10168

MOVEMENT AND STORAGE OF WATER IN NORTH CAROLINA SOILS,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
J. Fulton Lutz.
Available from NTIS as PB-194 531, $3.00 in paper copy, $0.65 in microfiche. North Carolina State University Soil Information Series No 15, April 1970. 29 p. OWRR Project No A-008-NC (3).

Descriptors: *Soil water movement, *Soil physical properties, *North Carolina, Bulk density, Hydraulic conductivity, Permeability, Porosity, Storage capacity, Infiltration, Percolation.
Identifiers: Coastal plain soils, Mountain soils, Piedmont soils.

The most important soil physical properties affecting the movement and storage of water in soils are given, including analyses for bulk density, total porosity, pore-size distribution, total and available water-holding capacity and hydraulic conductivity. Values are given for essentially all of the major soil series in North Carolina representing more than two-thirds of the total land area of the State. The hydraulic conductivity data are important for agricultural and urban uses of soils. Soils with extremely low hydraulic conductivities are unsuitable for septic tank installations because of poor drainage; those with extremely high hydraulic conductivities are unsuitable because of the danger of pollution. Information on the available and unavailable water-holding properties of soils is valuable from an agricultural standpoint, particularly to those who irrigate. Even if the degree of dryness of the soil is not accurately know, a good estimate of the amount of irrigation water needed can be obtained. (Grossman-USGS)
W70-10225

EMPIRICAL RELATIONS IN PROPERTIES OF UNCONSOLIDATED QUARTZ SANDS AND SILTS PERTAINING TO WATER FLOW,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia); and Australian Atomic Energy Commission Research Establishment, Lucas Heights.
For primary bibliographic entry see Field 02F.
W70-10245

POST-IRRIGATION MOVEMENT OF SOIL WATER 2. SIMULTANEOUS REDISTRIBUTION AND EVAPORATION,
Wisconsin Univ., Madison.
W. R. Gardner, D. Hillel, and Y. Benyamini.
Water Resources Research, Vol 6, no 4, p 1148-1153, August 1970. 6 p, 6 fig, 9 ref. USDA Grant FG-Is-163.

Descriptors: *Soil water movement, *Evaporation, *Percolation, *Irrigation water, *Evaporation control, Water conservation, Nuclear moisture meters, Soil moisture meters, Laboratory tests, Evapotranspiration.
Identifiers: Soil water redistribution.

Water content measurements by gamma-ray attenuation were made on soil columns during simultaneous redistribution and evaporation following irrigation. Redistribution is shown to reduce evaporation, in some cases appreciably. For a deep irrigation the redistribution proceeds at a rate that is relatively independent of the evaporation process, as has been predicted from numerical solutions of the flow equation. Expressions are derived for obtaining an estimate of amount of reduction in evaporation due to redistribution when the redistribution rate is known. (Knapp-USGS)
W70-10247

REVIEW OF COLLAPSING SOILS,
California State Coll., Long Beach. Dept. of Civil Engineering.
John H. Dudley.
ASCE Proceedings, Journal of the Soil Mechanics and Foundations Division, Vol 96, No SM 3, Paper 7278, p 925-947, May 1970. 23 p, 14 fig, 3 tab, 43 ref.

Descriptors: *Soil compaction, *Soil water movement, *Consolidation, *Subsidence, Soil mechanics, Soil physical properties, Soil structure, Wetting, Moisture content, Moisture tension.
Identifiers: Collapsing soils.

Soils which collapse (undergo large consolidation) when unusual amounts of water are added to them exist in many places around the world. Contrary to the ideas of many observers these collapsing soils derive from many different soil forming processes. Although surface collapse of 15 ft has occurred, the usual amount is considerably less. These soils are of open structure and exist in nature at less than 100% saturation. The major soil materials are silt, sand, or gravel or any of their combinations. Water in tension is the general binding material. A small amount of clay is present in many cases. Other binding agents sometimes contribute. The amount and rate of collapse is a function of grain shape, grain size, existing moisture content, kinds and amounts of clay present, void ratio, adsorbed ions, etc. Maximum collapse occurs at optimum clay content (10% in one case) and moisture content (between 13% and 39%). Most of the collapse can occur before the soil reaches 100% saturation. Estimates of the magnitude of possible collapse derived from routine tests generally are compared to field results. (Knapp-USGS)
W70-10256

HYDROGEN BONDING AND POLYWATER IN CLAY-WATER SYSTEMS,
Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
For primary bibliographic entry see Field 01A.
W70-10278

GENESIS OF CARBONATE PAN IN ARID REGION OF RAJASTHAN,
Central Arid Zone Research Institute, Jodhpur (India).
B. B. Roy, P. C. Chatterji, and S. Pandey.
Annals of Arid Zone, Vol 8, No 2, p 181-187, September 1970. 4 fig, 12 ref.

Descriptors: *Carbonates, *Hardpan, *Soil moisture, *Caliche, *Soil profiles, Soil chemistry, Magnesium, Calcium, Impervious soils, Soil types, Soil density, Subsoil, Geology, Geomorphology, Arid lands, Sands.
Identifiers: *India, *Thar Desert, *Pans.

The carbonate or 'kankar' pan occurs in all deserts of the world, usually concealed some distance under the sand. Several theories of pan formation are reviewed and discussed. A small area of the Rajasthan Desert was investigated, relating soil profiles, pan depth, vegetation, geology, geomorphology, and moisture conditions. Rock weathering, followed by release of Ca and Mg due to the action of carbonic acid in infiltrating rainwater, and formation of precipitated carbonates lead to a sub-surface cementation. Thickness of the Rajasthan pans indicates a very long geological past. The soils above the pan are all transported and therefore do not contribute to the formation of the thick zones. Groundwater in pan regions is saline, which, combined with their impervious structure, severely limits cultivation potential. These conditions and the sparseness of existing vegetation, in turn, enhance environmental aridity. (Casey-Arizona)
W70-10293

NATURAL CONDITIONS IN THE SOUTHERN PART OF THE CASPIAN SEMIDESERT,
A. G. Doskach.
Trans. from Russian. In: Genesis and Classification of Semidesert Soils. Israel Scientific Publications, p 2-20, 1968. Translated for the National Science Foundation and the U.S. Department of Agriculture by the Israel Program for Scientific Publications.

Descriptors: *Semiarid climates, *Climatology, *Geographical regions, *Geomorphology, Geology, Alluvial channels, Quaternary period, Tertiary period, Sediments, Clays, Soils, Geologic time, Water resources, Flood plains, Dry seasons, Wet seasons, Petrography, Rivers, Sands.
Identifiers: *Soviet Union, *Caspian Semidesert, *Paleogeography, *Tectonic uplift, Interfluves, Terrigenous materials, Fluvia.

The Caspian semidesert is a sea level plain with vast waterless expanses, lying to the north of the Caspian Sea. Total annual solar radiation is 115-120 calories per square centimeter. Mean annual precipitation is 160-175 millimeters, while

evaporability, due to dry summer winds, reaches 1000 millimeters. Spring, from late March to May, is characterized by very low rainfall, luxuriant ephemeral flowering and snow melts which effect groundwater recharge. Summer lasts through October and is very hot and dry with frequent winds and sporadic rainfall. Steady rainfall occurs in autumn and winter is freezing with a usually persistent snow blanket. Geologically, the area is part of the Caspian tectonic depression and there is a prevalence of marine or lacustrine-marine environments interrupted by relatively short terrigenous phases. Areal geomorphology is a result of a history of periodic changes in Caspian Sea volume and large discharge fluctuations in the ancient Volga and Ural rivers. The southern semidesert is divided into 10 discernable natural physicogeographical regions, and their geology and geomorphology are described in detail. (Casey-Arizona)
W70-10301

NATURAL FREEZING AND THAWING IN A SILT AND A SAND.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 02C.
W70-10411

INTERPRETING NEUTRON PROBE READINGS IN FROZEN SOIL.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 07B.
W70-10412

SOIL WATER MOVEMENT AS AFFECTED BY DEEP FREEZING,
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
Richard S. Sartz.
Soil Sci Soc Amer Proc Vol 33, No 3, p 333-337, May-June 1969.

Descriptors: *Soil water movement, *Frozen soils, *Gravitational water, *Hydrologic properties, *Infiltration, Moisture content, Percolating water, Permeability, Soil physics, Wisconsin.
Identifiers: Interflow.

Knowledge of water movement into and through frozen soils is needed for studying the hydrologic behavior of northern watersheds. Soil water was logged by the neutron method in both sandy and silty soils over four winters in southwestern Wisconsin. Bonded frost depth, which ranged from 8 to 120 cm at maximum penetration, was measured concurrently by frost probe or resistance blocks. Changes in soil water took place throughout much of the frost season, even with deep soil frost. One series of data showed that water may infiltrate and percolate through more than 60 cm of hard-frozen ground. However, frozen ground did impede percolation, causing a buildup of water in the frozen zone during spring melt. Although neutron readings increased at upper levels during the frost season, most of the increases could not be accounted for by decreases at lower levels. Thus, they appeared to result more from infiltration than from upward migration as reported by others. (Sartz-Forest Service)
W70-10414

WATER STORAGE AND RELATED PHYSICAL CHARACTERISTICS OF FOUR MINERAL SOILS IN NORTH CENTRAL MINNESOTA,
Forest Service (USDA), Grand Rapids, Minn. North Central Forest Experiment Station.
E. S. Verry.
USDA Forest Serv Res Note NC-78, 1969, 4 p, 4 tab, 2 ref.

Descriptors: *Water storage, *Soil water, *Soil types, *Minnesota, *Storage capacity, Mineralogy, Porosity, Soil surveys, Data collections.
Identifiers: Itasca County (Minn).

Soil water storage in 7.5 foot profile varied nearly 100 percent (7.9 to 15.5 inches) among four mineral soils ranging from a sand to sandy loam. Bulk density, size fractions, and four water retention values are tabulated for each horizon. (Verry-Forest Service)
W70-10426

2H. Lakes

EVOLUTION OF TRITIUM ACTIVITY IN THE SOUTH-WEST OF FRANCE (FRENCH),
Institute of Geology of the Aquitaine Basin, Bordeaux (France). Faculty of Sciences.
P. Leveque, M. Vigneaux, and J. Alvinerie.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/30, p 417-432, 1967. 16 p, 7 fig, 1 tab, 12 ref.

Descriptors: *Tritium, *Lakes, *Rain, *Groundwater, *Fallout, Water chemistry, Radioisotopes, Tracers, Clays, Sampling, Data collections, Hydrologic data.
Identifiers: France.

The tritium activity of rain, lake and underground waters has been under investigation in the Bordeaux area (south-west France) since 1964. The 250 or so analyses carried out show that changes in activity of rain water vary rather considerably, with a fairly marked over-all decrease over the period of about 30 months during which observations have been in progress. One of the lakes in the dunes along the coast of Aquitaine, Lake Cazaux, represents a special case by virtue of its hydrological and hydrodynamic features. The fact that this lake, with an area of about 60 sq km, has no notable source of supply other than precipitation makes it a seasonable integrator of the wide variations in the level of tritium activity in rainwater. A comparison with other lakes seems to confirm this hypothesis. There is a considerable lapse of time before periods of maximum rainfall are followed by an increase in the activity of surface water layers. The mean activities of some plants are similar to those found in the water of clays and the lake waters. (Knapp-USGS)
W70-10096

THE FLOW OF A STREAM THROUGH A RESERVOIR,
Gemeinnutziges Institut, Duesseldorf (West Germany).
For primary bibliographic entry see Field 02E.
W70-10111

INTERNAL CURRENTS RESULTING FROM INTERMEDIATE DENSITY INFLOWS INTO STRATIFIED RESERVOIRS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 02E.
W70-10121

DIEL VERTICAL MOVEMENTS AND FEEDING OF UNDERYEARLING SOCKEYE SALMON AND THE LIMNETIC ZOOPLANKTON IN BABINE LAKE, BRITISH COLUMBIA,
Fisheries Research Board, Nanaimo (British Columbia). Biological Station.
David W. Narver.
Journal of the Fisheries Research Board of Canada, Vol 27, No 2, p 281-316, 1970. 17 fig, 4 tab, 19 ref.

Descriptors: *Diurnal, *Movement, *Sockeye salmon, *Limnology, *Zooplankton, Seasonal, Depth, Thermocline, Epilimnion, Copepods, Daphnia, Sampling, Nets, Trout, Trawling, Temperature, Light intensity, Diptera, Alaska, Fish, On-site data collections.
Identifiers: *Vertical distribution, *Feeding habits, Diel vertical movement, Juvenile sockeye salmon, Babine Lake (Canada), Bosmina coregg
Heterocope septentrionalis, Daphnia longispr
Echo-sounder technique, Salmo gairdneri, P
seine, Diaptomus ashlandi, Chironomid.

A precise diel vertical movement of underyearl
sockeye salmon was observed in Babine L
(British Columbia). During early July to S
tember, at about 1.5 hours after sunrise to
hours before sunset, the young sockeye were in t
distinct layers at approximately 20 and 35 mete
each layer about 6 meters thick. About 1.5 ho
before sunset the two layers began to ascend.
0.5 hour after sunset all fish were within 3 meters
the surface, and during darkness were dispers
throughout the top 5-15 meters, with most f
below the thermocline. Soon after dawn the f
moved toward the lake surface, then descend
rapidly to daytime depths. By early October
behavior pattern changed and was temporally
sociated with epilimnion cooling and decrease
feeding intensity. Of zooplankton, only Bosmi
coregoni and Heterocope septentrionalis displa
pronounced diel vertical movements. Bosmina
habited surface waters during the day and we
found most abundant at 12-21 meters at nig
Heterocope inhabited the 21-30 meter depths du
ing the day and surfaced at night. Young socke
fed intensively in the evening near the surface a
at dawn prior to descent. (Jones-Wisconsin)
W70-10159

GROWTH OF PHYTOPLANKTON AN VASCULAR AQUATIC PLANTS AT DI FERENT NUTRIENT LEVELS,
Cornell Univ., Ithaca. Dept. of Botany.
H. F. Mulligan, and A. Baranowski.
Verhandlungen der Internationalen Vereinigu fur Theoretische und Angewandte Limnologie, V 17, p 802-810, 1969. 8 tab, 6 ref.

Descriptors: *Plant growth, *Phytoplankto *Aquatic plants, *Nutrients, Phosphorus, Ino ganic compounds, Nitrogen, Biomass, Sands, O ygen, Alkalinity, Hydrogen ion concentration, Tu bidity, Chlorophyll, Seston, Benthic flor Chlorophyceae.
Identifiers: *Vascular plants, Elodea canadensi Potamogeton crispus, Myriophyllum spicatum.

Greenhouse experiments to determine optim levels of organic nitrogen and phosphorus fo aquatic plant growth were conducted as basis fo establishing eutrophic conditions in ponds. Variou formulations, levels, and ratios of inorgani nitrogen and phosphorus were applied to culture of aquatic vascular plants (Myriophyllum spicatum var exalbescens, Potamogeton crispus and Elode canadensis) and freshwater phytoplankton popula tions (mostly Chlorophyceae) established in jar containing natural soil and water. Nutrient level applied ranged from 0.005 to 50 milligrams/lite nitrogen and 0.005 to 5.0 milligrams/lite phosphorus. The yields of experimental plants afte five weeks growth were used as response indices Highest nutrient levels produced the bes phytoplankton growth while the lower level resulted in higher vascular plant yields. Filamen tous algae grew best at intermediate nutrient levels High yields of vascular plants never coincided with large phytoplankton populations. At the highest nutrient levels, no vascular plant growth occurred. Of two inorganic phosphorus compounds evalu ated, super-phosphate of lime produced the greater yields. Smaller differences were apparent among three inorganic nitrogen compounds. These data suggest that future uncontrolled enrichment of natural bodies of water will result in growth of larger populations of phytoplankton at the expense of benthic macrophytes. (Jones-Wisconsin)
W70-10160

BLUE-GREEN ALGAL BLOOMS IN SASKATCHEWAN LAKES,
Saskatchewan Univ., Saskatoon.
U. T. Hammer.

Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 116t125, 1969. 3 fig, 3 tab, 29 ref.

Descriptors: *Cyanophyta, *Lakes, Temperature, Phosphates, Sampling, Seasonal, Diatoms, Eutrophication, Nitrates, Sewage, Physiocochemical properties, Nutrients, Depth, Chemical properties, On-site investigations.
Identifiers: *Water blooms, *Blue-green algae, Saskatchewan (Canada), Morphometry, Qu'Appelle River (Canada), Asterionella formosa, Anabaena flos-aquae, Aphanizomenon flos-aquae, Stephanodiscus, Microcystis aeruginosa, Oscillatoria prolifica, Fragilaria, Ceratium hirundinella.

An attempt was made to establish the relationship of bloom-forming blue-green algae with various physical, chemical, and biological components of lake environments in southern Saskatchewan, emphasizing effects of water temperature and orthophosphate levels on the production of blue-green algae blooms. The nutrient levels clearly place the Qu'Appelle River lakes in the eutrophic category, however application of algal indicators is questionable. Clearly both water temperature and orthophosphate concentrations play important roles in determining the predominance of the kinds of blue-green algal species together with the extent of production of individual species. Other factors undoubtedly also play important roles, such as the mean depth of the lake and consequently the amount of mixing of bottom materials with the main water mass. This may, in fact, involve the organic materials which have been considered important to blue-green production. That these are not strictly necessary was demonstrated with Aphanizomenon. Anabaena flos-aquae had been grown in fresh water medium with inorganics only present. However, it appears likely that proximity with water churned up from the bottom by constant winds does have a beneficial effect on algal growth. (Jones-Wisconsin)
W70-10165

THE UTILIZATION OF FOOD BY THE ZOOPLANKTON FOR ITS GROWTH (IN RUSSIAN),
N. M. Kryuchkova.
Zhurnal Obshchei Biologii, Vol 30, No 4, p 418-425, 1969. 2 fig, 1 tab, 34 ref.

Descriptors: *Zooplankton, *Lakes, *Food chains, Aquatic populations, Foods, Growth rates, Environmental effects, Metabolism, Algae, Daphnia, Copepods, Food webs, Aquatic animals, Laboratory tests.
Identifiers: *Growth utilization coefficients, Food assimilation, Food consumption.

Solution of many problems pertinent to the biological cycle of water basins requires the knowledge of values characterizing the consumption of food by aquatic animals and utilization of consumed food in the processes of growth. A survey of related literature has indicated that the average coefficient of the growth utilization of consumed food (K-sub-1) for freshwater zooplankton is 21.6%, whereas the coefficient of utilization of assimilated food (K-sub-2) is 40%. The same coefficients for marine zooplankton are 25.4% and 39.2%, respectively. The coefficient of food assimilation by both freshwater and marine animals is approximately 60%. These values were obtained in laboratory trials. The species of algae, used as food, not always answered the requirements of the test animals. Therefore, under natural conditions the efficiency of food utilization may be higher than that observed in laboratories. (Wilde-Wisconsin)
W70-10166

MICROBIOLOGICAL PROCESSES OF IRON TRANSFORMATION IN A MEROMICTIC LAKE (IN RUSSIAN),
Akademiya Nauk SSSR, Moscow. Institut Mikrobiologii.
G. A. Dubinina, and Z. P. Deryugina.
Zhurnal Obshchei Biologii, Vol 30, No 5, p 602-610, 1969. 2 fig, 5 tab, 13 ref.

Descriptors: *Lakes, *Iron, Hypolimnion, Iron bacteria, Oxygenation, Mud, Nutrients.
Identifiers: *Meromictic lakes, *Ferrous iron, Lake Okha-Lampi (USSR), Lake Uzornoye (Western Karelia SSR), Gallionella ferruginea, Hydroxides.

The meromictic Lake Okha-Lampi ('Ornamental') in western Karelia exhibits near its bottom a highly increased concentration of ferrous iron, up to about 100 milliliter/liter. The oxygenated upper part of the iron-enriched zone harbors a very dense population of Gallionella ferruginea and other iron bacteria, comprising 50% to 75% of the entire bacterial population. The diffusion of the hypolimnion iron into the upper strata and its removal from the lake are precluded by bacterial transformation of ferrous compounds into the form of insoluble hydroxides. Consequently, the iron accumulates in mud deposits and benthic water layers. (Wilde-Wisconsin)
W70-10167

THE GENERAL ANALYSIS OF A EUTROPHIC SYSTEM,
Alberta Univ., Edmonton. Dept. of Zoology.
J. R. Nursall.
Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 109-115, 1969. 2 fig, 2 tab, 18 ref.

Descriptors: *Eutrophication, *Analysis, *Lakes, Cyanophyta, Systems analysis, Physiocochemical properties, Seasonal, Geology, Phytoplankton, Scenedesmus, Antarctic, Thermodynamic behavior, Zooplankton, Biota, Ice, Temperature, Aquatic plants, Euglenophyta, Mysobacteria, Environment, Energy, Indicators, Water pollution effects, Water pollution sources.
Identifiers: Edmonton (Canada), Alberta kettle lakes, Astotin Lake (Canada), Aphanizomenon flos-aquae, Anabaena, Asterionella formosa, Cyclotella meneghiniana, Microcystis aeruginosa, Melosira italica, Nitzschia, Spaherocystis schroeteri, Schizothrix calcicola, Morphometry, Allochthonous material.

An ice-free lake exchanges matter with its environment; covered with ice the lake is a closed system. Major sources of matter for exchange in an open lake system are allochthonous material and organic production by biota; the latter representing a second open system exchanging with the first. The exchange between lake and its environment is unequal; more matter enters the lake from both sources than leaves it, which is the basis of eutrophication. It is enhanced by slowdown of material exchange (or increased rate of accumulation) during the closed period. Since exchange of energy and input of allochthonous material are both independent and unpredictable variables, the nature of the biota also varies unpredictably and contributes its matter inestimably. Biota is opportunistic and variable--predictable only under strongly definable limiting conditions. It follows that the nature and rate of eutrophication is unpredictable nor are biotic indicators reliable, except in special instances of definable rate of constant pollution. Periods of transition between open and closed phases are those of great heat energy loss by a lake system. The variable effects of these periods markedly affect the conditions of the succeeding phases, particularly the closed phase. (Jones-Wisconsin)
W70-10170

MODELING SPREAD OF HEATED WATER OVER LAKE,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering and Hydraulics.
For primary bibliographic entry see Field 05G.
W70-10212

AN ASSESSMENT OF THE WAVE AGITATION IN THE SMALL BOAT BASIN AT THE CANADA CENTRE FOR INLAND WATERS,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
T. M. Dick, and J. Marsalek.
Canada Department Energy, Mines and Resources, Inland Waters Branch Technical Bulletin No 28, 1970. 61 p, 24 fig, 8 tab, 3 ref, append.

Descriptors: *Breakwaters, *Waves (Water), *Harbors, *Lake Ontario, Hydraulic models, Model studies, Coastal engineering, Coastal structures, Marinas.
Identifiers: Hamilton Harbor (Ontario).

The geometry of the small boat basin at the Canada Center for Inland Waters causes multiple reflections of any wave agitation which enters. Consequently, there is a limit to the amount that wave heights can be attenuated by a practical arrangement of additional breakwaters. Hydraulic model studies were made to determine the probability of dangerous wave conditions and the possibility of correcting the problem by constructing breakwaters. The occurrence of undesirable conditions will probably not exceed four days during the navigation season and the best scheme will still require special mooring arrangements for the worst storms. It is recommended that a buoy mooring system be installed but additional breakwaters should not be constructed until further experience is gained. (Knapp-USGS)
W70-10262

TRITIUM IN CRATER LAKE, OREGON,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
For primary bibliographic entry see Field 05B.
W70-10269

STUDIES ON CENTRAL AFRICAN PANS III: FAUNA AND PHYSICO-CHEMICAL ENVIRONMENT OF SOME EPHEMERAL POOLS,
University Coll. of Rhodesia and Nyasaland, Salisbury. Dept. of Zoology.
J. S. Weir.
Hydrobiologia, Vol 33, No 2, p 93-116, 1969. 4 fig, 9 tab, 35 ref.

Descriptors: *Water holes, *Biomass, *Productivity, *Food webs, *Ecology, Arid lands, Precipitation, Aquatic productivity, Secondary productivity, Eutrophication, Frogs, Birds, Fish, Invertebrates, Aquatic animals, Aquatic populations.
Identifiers: *Pans, *Kalahari desert, *Rhodesia, *Tadpoles.

The innumerable small pools and seasonal lakes formed during the rainy season in Central Africa are disappearing because of agriculture and public health control measures. Twelve shallow, representative pans in the Kalahari desert were sampled and analyzed for physico-chemical and biological data when full of water, drying, and dry. Temperatures fluctuated over an 18 degree daily range, and mud was cooler than surface water, offering animals shelter from the thermal stress. Macroscopic fauna from small invertebrates through amphibians were sampled, listed and analyzed for numbers and biomass. Gut content analyses and feeding trials enabled determination of food habits and subsequent construction of hypothetical food webs. Biological productivity was estimated at 2500 kilograms per hectare per year, which compares favorably to the productivity of shallow fish ponds in the same region. Organic matter and pollution were present according to the presence and amounts of animal dung and seasonal vegetation, which in turn determined faunal diversity and biomass. Tadpoles were exteremely numerous and were benthic detritus feeders. Polluted alkaline pools with tadpoles had the greatest biomass. The possibility is discussed of integrating pan productivity into African game ranching programs. (Casey-Arizona)
W70-10296

IN RE BD OF SUPERVISORS (DETERMINATION OF LAKE'S NATURAL WATER LEVEL BY A COURT).

276 Mich 591, 268 NW 750-752 (1936).

Descriptors: *Michigan, *Lakes, *Water levels, *Jurisdiction, Water measurement, Height, Flumes, Fluctuation, Variability, Water loss, Evaporation, Seepage, Inland waterways, Lake shores, Sea level, Elevation, Adjudication procedure, Judicial decisions, Legal aspects.

Appellee board of supervisors petitioned the circuit court for a determination of the natural height and level of the water of two inland lakes. The petition was based upon a state statute conferring jurisdiction in such matters on state circuit courts. Appellant village contested the petition. After hearing expert testimony, the circuit court entered its order fixing the level of the lakes. Appellant contended that the statute did not and could not confer the right to fix the water level of the lakes upon the circuit court. The Supreme Court of Michigan affirmed the circuit court's order, holding that the statute conferred jurisdiction upon the circuit court to determine the natural water level of the lakes. (Quesada-Florida)
W70-10480

2I. Water in Plants

INVASION OF THE AQUATIC HABITAT BY AMPHIBIOUS SPECIES OF POLYGONUM,
Virginia Polytechnic Inst., Blacksburg. Dept. of Botany.
Richard S. Mitchell.
Available from NTIS as PB-194 454, $3.00 in paper copy, $0.65 in microfiche. Project Completion Report, August 1970. 24 p, 3 fig, 4 ref. OWRR Project A-028-VA (1).

Descriptors: *Aquatic plants, *Amphibious plants, *Plant tissues, *Plant morphology, Aquatic weeds, Rooted aquatic plants, Vegetation regrowth, Tropisms, Epidermis, Foliar, Moisture stress, Growth chambers, Plant ecology, Smartweeds, Polygonum.

This report covers a two year study of the aquatic capabilities of members of the plant genus Polygonum (section Persicaria). Amphibious water-weeds of this group are capable of covering the entire surface of a reservoir within two years. Included in the study is discussion of the rediscovery of P. meisnerianum, a little known invader of lakes. A leaf anatomy study is discussed, but the major body of data is reserved for later publication. A series of experiments on tropisms is discussed in full. These indicate that prostrateness is partially genetically controlled and partially an inhibition o negative geotropism by light. Plagiotropy was most pronounced in amphibious plants. A series of inundation experiments was carried out in environmental chambers. After cloning the plants they were separated into two groups, one of which was submerged in an aquarium and the other grown aerially as a control. Vegetative and anatomical comparisons were made after 30 days, and 23 populations were ranked on their amphibious responses to submergence. Amphibious varieties of P. amphibium scored highest, as expected, but P. amphibium var. emersum scored below some less closely related taxa. The work strengthened suspicions that P. amphibium is of Eurasian origin with no close relatives here; however, P. densiflorum which is distantly related, appears on the verge of becoming a true aquatic.
W70-10113

FACTORS AFFECTING DETERMINATION OF IRRIGATION WATER REQUIREMENTS,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 03F.
W70-10134

GROWTH OF PHYTOPLANKTON AND VASCULAR AQUATIC PLANTS AT DIFFERENT NUTRIENT LEVELS,
Cornell Univ., Ithaca. Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-10160

MANAGEMENT OF AQUATIC VASCULAR PLANTS AND ALGAE,
Cornell Univ., Ithaca, N.Y. Dept. of Botany.
Hugh F. Mulligan.
Eutrophication: Causes, consequences, correctives, p 464-482. Printing and Publishing Office, National Academy of Sciences, Washington, D.C., 1969. 2 tab, 110 ref.

Descriptors: *Aquatic weed control, *Aquatic plants, *Herbicides, *Vascular tissues, *Algae, Ecosystems, Chara, Benthic flora, Floating plants, Phytoplankton, Aquatic insects, Fish, Game birds, Animals, Food chains, Oxygen, Rotifers, Weeds, Water hyacinth, Alligatorweed, Chemcontrol, Mechanical control, Biocontrol, Copper sulfate, Sodium arsenite, Diquat, Toxicity, Snails, Mammals, Tilapia, Carp, Fertilization, Northeast US, New York, Tennessee Valley, 2-4-D.
Identifiers: Ceratophyllum, Myriophyllum, Eichhornia, Potamogeton, Trapa, Pistia, Alternanthera, Heteranthera, Najas, Silvex, Endothal, Potassium permanganate, Fenac, Silver nitrate, Simazin, Nuphar, Agasicles, Manatee, Marisa.

Chemical treatments offer, at best, temporary relief from overabundance of aquatic vegetation. Even when excellent results are obtained, treatments must be repeated annually. Presently, aquatic herbicides are nonselective, usually killing all plants by contact. It would be more efficacious to use aquatic herbicides possessing selective toxicity against specific aquatic weeds, thus permitting the reestablishment of desirable plants. The cost of developing aquatic herbicides would be greater as apposed to agricultural herbicides because of the specialized testing requirements, and generally, the potential market would not be as great. Mechanical control is very promising: it involves hand-pulling or cutting and harvesting plants from restricted areas. Biological control has met with only limited success, but is an avenue of promising potential. This approach would include introducing organisms that are inimical to the target organisms and manipulating the existing aquatic environment. In a concept, this type of control uses biology against biology. Among the organisms utilized in control of aquatic plants are fish, snails, mammals, and beetles. Biological control is the only method that could provide a permanent solution to the problem of excessive aquatic vegetation. (See also W70-03975) (Jones-Wisconsin)
W70-10175

IMPROVING TREE TRANSPIRATION ESTIMATES BASED ON HEAT PULSE VELOCITY MEASUREMENTS,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02D.
W70-10286

WATER RELATIONS OF MAIZE: PART 1. - EFFECTS OF SEVERE SOIL MOISTURE STRESS IMPOSED AT DIFFERENT STAGES OF GROWTH ON GRAIN YIELDS OF MAIZE,
Rhodesia Dept. of Research and Specialist Services, Salisbury.
For primary bibliographic entry see Field 03F.
W70-10289

WATER RELATIONS OF MAIZE: PART 2. - THE EFFECTS OF NINE IRRIGATION REGIMES ON MAIZE,
Rhodesia Dept. of Research and Specialist Services, Salisbury.
For primary bibliographic entry see Field 03F.
W70-10290

EFFECTS OF SIMULATED GRAZING ON SO MOISTURE CONTENT IN MID-ELEVATI RESEEDED RANGELAND,
Utah State Univ., Logan.
For primary bibliographic entry see Field 03F.
W70-10291

CRITICAL FACTORS DURING THE FIRE YEARS OF LIFE OF THE SAGUARO (CEREE GIGANTEUS) AT SAGUARO NATIONA MONUMENT, ARIZONA,
Saguaro National Monument, Tucson, Ariz.; a
Arizona Univ., Tucson.
Warren F. Steenbergh, and Charles H. Lowe.
Ecology, Vol 50, No 5, p 825-834, Late Summ 1969. 8 fig, 2 tab, 15 ref.

Descriptors: *Cacti, *Arizona, *Environmental l fects, *Germination, *Vegetation establishme Desert plants, Arid lands, Drought, Rainfall, Limi ing factors, Plant growth, Plant populatio Growth rates, Growth stages, Plant physiolo Age, Seeds, Population, Habitat, Microenviro ment, Viability, Mortality, Rodents, Insects.
Identifiers: *Saguaro cactus, *Sonoran Dese *Seedlings.

During 1965-1966 the germination and establis ment of giant saguaro (Cereus giganteus Engelm were investigated in field studies at Saguaro N tional Monument, Arizona. Field germination e periments were conducted and natural seedli populations were periodically observed in fl rolling hill, and rocky terrain habitats. The reaso that such a small number of saguaro germinatio occur are bird, mammal, and insect predation the seeds and also insufficient moisture for g mination. Germination begins in July after the sta of the summer rains and continues into Septembe These rains are important because they dislod seeds from fruits, transport the seeds to protect sites and provide moisture for germination. To precipitation is greater on the flats and rolling hi than in the rocky habitat, which may partially e plain the lower germination rates in the latter are Seedling mortality, however, is lowest in rocky te rain. Seedling establishment is limited by rodent insects, frost, and drought, with size and extent seedling growth appearing to depend primarily soil moisture availability immediately below t soil surface. Principal apical stem growth occu during the summer rains. New growth also tak place during the winter rains of February ar March. (Carr-Arizona)
W70-10292

THE EXPECTED EFFICIENCY OF WATE UTILIZATION IN PLANTS UNDER DIFFEREN COMPETITION AND SELECTION REGIMES,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany
For primary bibliographic entry see Field 02D.
W70-10294

WHY CONSERVE NATURAL VEGETATION,
B. Verdcourt.
In: Conservation of Vegetation in Africa South the Sahara, p 1-9, Acta Phytogeographica Suecic 54, Uppsala, 1968. 14 refs.

Descriptors: *Forests, *Watersheds (Divides *Ecology, *Ecosystems, *Vegetation effects Evapotranspiration, Runoff, Water conservation Social impact, Conservation, Erosion, Fertility, So conservation, Soil moisture, Soil stabilization, Soil water-plant relationships, Infiltration.
Identifiers: *Disturbed areas.

The author argues for widespread conservation o natural vegetation from both philosophical an practical considerations. Practical values discusse include direct uses such as drug and new foo sources, scenic values, climatic effects and energ conservation, but particularly stressed are wate supply maintenance, prevention of soil erosion an conservation of soil fertility. East Africa catchment area studies have shown that natural o well managed forests are unsurpassed for maximum

infiltration and natural control of stormflow or surface rungoff. This is primarily due to the combination of very porous soils, surface litter and the protective canopy which prevents erosion during intense tropical rains. When disturbances occur, such as the introduction of grazing animals during lowland dry seasons, water and nutrient retention capacity is severely damaged. A draw back with forests, however, is the tremendous water loss due to evapotranspiration, and in areas of less than 40-50 inches yearly rainfall, cultivation of arable land may actually increase ground water supplies. Similar examples may be drawn from other areas of natural vegetation. The goals of the ecologist and the agronomist are often counter to each other. (Casey-Arizona)
W70-10300

SODIUM-22 RETENTION AS A FUNCTION OF WATER INTAKE BY CITELLUS LATERALIS,
New Mexico Univ., Albuquerque. Dept. of Biology.
Gary L. Bintz.
In: Physiological Systems in Semiarid Environments, University of New Mexico Press, p 45-52, 1969. 2 fig, 1 tab, 6 ref. Contract AT (29-2)-1629 USAEC.

Descriptors: *Xerophilic animals, *Moisture deficit, *Water balance, *Rodents, *Radioactivity techniques, Metabolism, Physiological ecology, Moisture stress, Animal physiology, Sodium, Laboratory tests, Semiarid climates.
Identifiers: *Ground squirrels, *Hibernation, *Biological half-life, Field-adapted animals, Laboratory-acclimated animals, Water excretion.

Hibernating animals are apparently able to tolerate water stress for at least 3 weeks. Some evidence indicates the ability to carry this tolerance over into non-hibernating periods. Additionally there are indications that laboratory-acclimated animals do not retain the ability. Recently captured and laboratory-acclimated ground squirrels were subjected to differing water intakes for 1 week and then injected with Na-22. Their radioactivity retention was then measured over a period time. Lab animals excreted 22% of the isotope in the first 24 hours following injection, while field animals excreted only 7 percent. Retention in lab animals indicated approximate water requirements of 10 milliliters per 100 grams body weight per day while those of field animals were 5 milliliters per 100 grams body weight per day. Above a minimal water-intake level Na excretion appeared independent of water excretion. Either field animals posses a water stress tolerance mechanism subsequently lost by lab animals or lab animals are overhydrated and able to lose more water before water conservation becomes critical. (Casey-Arizona)
W70-10304

CHALLENGES AND OPPORTUNITIES FOR DESERT PLANT PHYSIOLOGISTS,
Nevada Univ., Reno. Desert Research Inst.
F. W. Went.
In: Physiological Systems in Semiarid Environments, p 219-230, University of New Mexico Press, Albuquerque, 1969.

Descriptors: *Xerophytes, *Competition, *Inhibitors, *Plant growth, *Distribution patterns, Ecology, Shrubs, Physiological ecology, Seeds, Arid lands, Osmotic pressure, Precipitation (Atmospheric), Temperature, Root systems, Tropical regions, Desert plants, Rainfall disposition, Germination, Soil-water-plant relationships.
Identifiers: *Autoinhibitors, *Climatic factors, *Annuals (Plants), Mojave Desert, Mycorrhizas, Seed production.

The problems involving water balance in desert plants are: (1) The mechanisms by which transpiration levels are reduced far below those achievable merely by stomatal closure; (2) The reasons why annuals do not extend their root systems beyond a very shallow soil layer in order to extract more water from a larger soil volume, and whether or not upper soil layer dew formation is a factor. Competition, contrary to general views, is felt to be at most a minor factor in plant distribution. Seed populations are controlled by animals and germination is selected for by precise germination control mechanisms. A number of examples are given in which the other plants in the neighborhood of a given plant do not exert limiting factors on its growth. Additionally, what were formerly considered intraspecific growth inhibitors produced by roots of desert shrubs such as Larrea are now considered autoinhibitors. All growth regulation seems to be independent of neighboring plants and it is suggested that this theory may also be extended to plant growth and distribution in non-desert areas. (Casey-Arizona)
W70-10305

PHYSIOLOGICAL RESPONSES OF PLANTS TO SALINITY: PLANT-WATER RELATIONS,
Arizona Univ., Tucson. Environmental Research Lab.
James J. Riley.
In: Physiological Systems in Semiarid Environments, p 249-254, University of New Mexico Press, Albuquerque, 1969. 3 tab, 2 fig, 9 ref.

Descriptors: *Osmotic pressure, *Salt tolerance, *Soil-water-plant relationships, *Transpiration, Sodium Chloride, Sulphates, Chlorides, Calcium, Stomata, Diffusion, Leaves, Physiological ecology, Plant physiology, Saline water, Root systems.
Identifiers: *Plant water potential, *Plant pressure potential, *Root water resistance, *Sap contents, Ethylene glycol, Physiological drought.

Although saline water reduces plant growth, the exact physiological systems are not understood. Red kidney bean (Phaseolus vulgaris) seedlings grown hydroponically were gradually brought to 2 and 4 atmospheres above medium level with single salt solutions of NaCl, calcium chloride, sodium sulfate or carbowax 1540 (ethylene glycol). Except with NaCl solutions, the osmotic gradient between solution and leaves decreased with increasing concentration. In all cases, water potential gradients between leaves and solution decreased with increasing concentration. Both root resistance to water movement and leaf diffusion resistance were higher in treated plants than controls. In plants treated with carbowax and sodium sulfate a water potential adjustment occurred and transpiration levels were higher. It was concluded that: (1)Sap osmotic adjustment does not indicate a water potential adjustment (2) Resistance to water movement, especially in roots may be an important consideration. (Casey-Arizona)
W70-10306

THE EFFECT OF SALT CONCENTRATION ON THE GROWTH AND METABOLISM OF A SUCCULENT HALOPHYTE,
Utah Univ., Salt Lake City. Dept. of Botany.
Irving McNulty.
In: Physiological Systems In Semiarid Environments, p 255-262, University of New Mexico Press, Albuquerque, 1969. 6 fig. NSF Grant GB-3485.

Descriptors: *Xerophytes, *Halophytes, *Soil-water-plant relationships, *Salt tolerance, *Chlorides, Plant physiology, Physiological ecology, Metabolism, Plant growth, Respiration, Photosynthesis, Arid lands, Osmotic pressure, Sulphates, Sodium, Potassium, Laboratory tests, Leaves, Light, Carbon dioxide, Stomata, Salts.
Identifiers: *Succulents, *Greasewood, *Physiological drouth, Environmental chambers, Succulence, Photosynthesis-respiration ratios, Water potential, Seedlings.

Seedlings of a woody, succulent-leafed halophyte, greasewood (Sarcobatus vermiculatus Hook), were grown in nutrient media and 50- or 100-millimolar increments of NaCl, KCl or sodium sulfate were added at 3- or 10-day intervals until a final concentration of 1 millimolar was achieved. Lear osmotic adjustments occurred rapidly in all treatments maintaining a favorable water gradient of 2-3 times greater osmotic pressure than the root medium. Small amounts of salt stimulated growth while larger amounts were inhibitory. Maximal growth concentrations were 2 atmospheres for chloride solutions and 5 for sulfate solutions, indicating that chloride ion rather than osmotic pressure was the inhibitory factor in the growth medium. Respiratory rates in salt-treated plants were below control levels. Inhibition of photosynthesis with NaCl increased with concentration. The photosynthesis-respiration ratio was also inversely proportional to salt concentration and indicated a greater reduction in photosynthesis than respiration. Leaf succulence as measured by length-thickness ratios increased with chloride concentration. The more succulent form may not be as efficient in carbon dioxide uptake. (Casey-Arizona)
W70-10307

GRADIENTS IN SPECIES COMPOSITION OF DESERT VEGETATION NEAR EL PASO, TEXAS,
Texas Univ., Arlington. Dept. of Biology.
John S. Williams.
In: Physiological Systems in Semiarid Environments, p 273-283, University of New Mexico Press, Albuquerque, 1969. 3 fig, 2 tab, 13 ref.

Descriptors: *New Mexico, *Xerophytes, *Arroyos, *Arid lands, *Soil-water-plant relationships, Ecology, Geology, Geomorphology, Alluvial channels, Soils, Vegetation establishment, Vegetation regrowth, Climates, On-site investigations, Plant populations.
Identifiers: *Rio Grande Valley, *Plant communities, *Species composition, *Importance values, Disturbing factors.

Gradients in species composition in plant communities are effected by a variety of interacting environmental factors that are often difficult to isolate and measure. In this paper vegetation, soils, climate geology and geomorphology of the Rio Grande Valley are described and historical records are reviewed. This area is an arid region with great phytographic diversity resulting mainly from various disturbing factors. It is subject to the formation of many new arroyos and deepening of older ones. Plant communities in the arroyos were surveyed; importance values of species determined; and species compositions correlated with arroyo structure. Two important plants were Fouquieria splendens, whose presence delineated arroyo importance, and Larrea divericata, which disappeared as arroyo deepening increased. Other importance species were tabulated and their significance described. In terms of plant communities, 4 overlapping zones were observed as arroyo development progressed. (Casey-Arizona)
W70-10308

THE ECOLOGICAL BACKGROUND TO LAND-USE STUDIES IN TROPICAL AFRICA, WITH SPECIAL REFERENCE TO THE WEST,
Birmingham Univ. (England). Dept. of Geography.
R. P. Moss.
In: Environment and Land Use in Africa, Chapter 8, p 193-238, Methuen, London, 1969. 10 fig, 6 tab, 129 ref.

Descriptors: *Soil-water-plant relationships, *Soil properties, *Ecology, *Agriculture, *Land use, Evapotranspiration, Precipitation (Atmospheric), Tropical regions, Arid lands, Semiarid climates, Animal populations, Plant populations, Planning, Rain forests, Nutrients, Fire, Grazing, Water distribution (Applied), Habitats, Biomass, Ecosystems, Grasslands.
Identifiers: *West Africa, *Ecological-agricultural interrelationships, *Nutrient cycling, *Game ranching.

Studies of land use patterns must be in terms of the ecological and agricultural factors that produced them and therefore involve insight into the strong interdependence between vegetation and soils.

Various ecosystems in West Africa--humid rain forests, savannahs, arid areas and montane regions--are therefore evaluated in this light. Tropical rain forests are characterized by high precipitation, high evapotranspiration, low percolation and low runoff. Organic and mineral nutrient recycling systems are virtually closed and constant. Savannahs are more widespread than forest areas and are characterized by: (1) much less vegetational biomass; (2) seasonal rather than continual water and nutrient cycling; (3) fire as an important ecological factor; and (4) horizontal zonation due to climatic, edaphic and anthropogenic factors. The present fauna and flora of forest and savannah are described, as well as their agricultural potentialities and limitations. Montane regions are complex and hold great agricultural potential but are also important watersheds. The implications of land use go beyond plants and soils and also include pest and disease patterns involving plants, animals and humans--all of which need to be rationally assessed. (Casey-Arizona)
W70-10309

THE DORMANCY AND SURVIVAL OF PLANTS IN THE HUMID TROPICS,
Ghana Univ., Legon. Dept. of Botany.
K. A. Longman.
Symposium of the Society of Experimental Biology, Vol 23, p 471-488, Cambridge University Press, 1969. 6 fig, 3 tab, 32 ref.

Descriptors: *Germination, *Photoactivation, *Temperature control, *Moisture availability, *Tropical regions, Humid climates, Humidity, Physiological ecology, Ecology, Plant physiology, Growth stages, Laboratory tests.
Identifiers: *Dormancy, *Pre-dormancy, *Budbreak, Bud dormancy, Seed dormancy.

Contrary to widespread belief, tropical climates may be highly variable. Consequently, plant growth is highly variable and dormancy is common. Two kinds of dormancy are considered: (1) bud dormancy in forest trees (2) seed dormancy in weeds colonizing open, disturbed ground. Short day-length lab experiments on several tropical tree species showed pre-dormancy mechanisms characterized by reduction or absence of both shoot growth and leaf production. After some time, with unchanged photoperiod, bud-break and renewed leaf expansion occurred. Temperature and photoperiod seem to be the initiating factors, although extrapolation of lab results to field conditions must be done cautiously. Mature plants and seedling differ distinctly in photoperiod responses and growth habits, the dormant period increasing with seedling age. In many tree species the short yearly growth period is precisely timed and occurs during the dryer season, probably because solar radiation and temperature are more crucial limiting factors than moisture. Unlike bud dormancy, tropical seed dormancy is more closely related to survival during dry periods and germination therefore occurs during rainy seasons. Since temperature, rain and photoperiod are all functionally related, different combinations of these depending on the species, may, as in the desert, trigger germination. (Casey-Arizona)
W70-10313

WATER REGULATION ON FOREST LAND.
Forest Service (USDA), Charleston. Southeastern Forest Experiment Station.
Ralph A. Klawitter.
Journal of Forestry, 68 (6):338-342, June 1970.

Descriptors: *Wetlands, *Coniferous forests, *Design criteria.
Identifiers: *Water regulation, *Timber production, *Bays, *Bottomlands, *Wet flats.

One key objective of water regulation on wet forest land is to increase timber production. Other objectives are to improve wildlife habitat, range land, and flood control. Wetland forests vary widely in site conditions and in their responses to water and soil management. Each kind--swamps, bottomlands, bays, and wet flats--must receive a prescription suited to local peculiarities, because water regulation works best when properly applied to the task for which it is designed. Measures applied, however, must be well enough understood and sufficiently controlled to enable changes in design and shifts in productivity from one resource use to another as the future demands.
W70-10408

DOES BEDDING PROMOTE PINE SURVIVAL AND GROWTH ON DITCHED WET SANDS.
Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station.
Ralph A. Klawitter.
Northeastern Forest Experiment Station, USDA, Forest Service Research Note NE-109, 1970. 4 p.

Descriptors: *Drainage, *Plant growth, *Pine trees, *Wetlands, *Sands, Florida.
Identifiers: *Bedding, *Survival.

Results from a study of prepared beds for planting slash pine on a wet sandy flat in Florida were inconclusive. Early growth was improved, but survival was not; and differences between a bedded site and an unbedded site were slight.
W70-10409

2J. Erosion and Sedimentation

PROBING THE MEDITERRANEAN'S HIDDEN GEOLOGICAL PAST.

Science News, Vol. 98, No. 1, p. 20-21, July 4, 1970. 2 fig.

Descriptors: *Sedimentology, Structural geology, *Drilling, *Geologic time.
Identifiers: *Deep Sea Drilling Project, Glomar Challenger, *Mediterranean Ridge, Tethys, Nile Cone.

The thirteenth voyage of the deep sea drilling ship Glomar Challenger will be an expedition to the Mediterranean Sea. Drillings will be made in over ten sites at a depth of approximately 1000 meters below the sea bottom. The expedition will attempt to unravel the geological history of the Mediterranean sea and its adjacent land masses as well as the chronology of faunal changes and organic deposits. Such puzzles as the formation of the Mediterranean Ridge and of the three basins in the western Mediterranean, and the disappearance of the Tethys waterway will be investigated. (Holmes-Rutgers)
W70-10184

FOSSIL WATER,
Geological Survey, Woods Hole, Mass.
For primary bibliographic entry see Field 02K.
W70-10234

FLUME WIDTH AND WATER DEPTH EFFECTS IN SEDIMENT-TRANSPORT EXPERIMENTS,
Geological Survey, Washington, D.C.
Garnett P. Williams.
For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC , 20402 - Price 55 cents. US Geological Survey Professional Paper 562-H, 1970. 37 p, 17 fig, 2 tab, 26 ref.

Descriptors: *Sediment transport, *Flumes, *Width, *Hydraulic similitude, *Hydraulic models, Laboratory tests, Alluvial channels, Bed load, Channel morphology, Hydraulics.
Identifiers: Sediment transport flumes, Width effects.

This paper reports 177 flume experiments made in channels of different widths and water depths, to find how the flume dimensions influence exp mental results. Sediment transport rates, grain s water depth, and channel width were controll the dependent variables were water discha mean velocity, slope, and bed-form. The flu widths were 0.25, 0.5, 1.0, and 2.0 ft. In a channe ft wide flume sidewall effects very nearly completely disappeared. Narrower channels, wh wall effects were pronounced, could therefore compared to wide channels in which wall effe were absent. The slope decreased as the chan became wider, for a given unit transport rate a water depth. Multiplying the laboratory value slope, unit stream power, or shear stress by the justment factor gives the slope power, or shear fo wide channel for the same water depth and u sediment-transport rate. Adjustment factors a are given for correcting the unit sediment-transp rate for sidewall effects, taking transport rate a dependent variable and stream power as the fl quantity which governs transport rate. Tests of validity of the Johnson-Brooks sidewall correcti procedure showed that for the present movab bed data the degree of agreement between p dicted and measured flow depths varied with hydraulic or transport conditions. Best agreeme usually occurred with channels 1 ft or more wi and for runs which did not have extremely rou beds. A review of the literature suggests that many rigid-boundary flows this sidewall correcti procedure is reasonably reliable. (Knapp-USGS)
W70-10244

EFFECT OF A POROUS SAND BED ON I CIPIENT SEDIMENT MOTION,
Georgia Inst. of Tech., Atlanta.
C. S. Martin.
Water Resources Research, Vol 6, No 4, p 116 1174, August 1970. 13 p, 9 fig, 25 ref. OWRR Pr jects B-004-GA and B-019-GA.

Descriptors: *Sediment transport, *Scour, Strea erosion, *Sands, *Permeability, Porous media, A luvial channels, Seepage, Groundwater movemen Deposition (Sediments), Waves (Water), Shea Shear drag, Shear stress, Model studies, Hydraul models.
Identifiers: Sediment movement.

Incipient motion tests were conducted for flow in and out of a porous bed. Seepage out of a bed do not affect incipient motion measurably because th seepage force is lost once a sediment particle rock Seepage into a bed may either enhance or hind incipient motion, depending upon the relative e fect of the boundary shear stress and the seepag force, both of which depend on the seepage flow For a given hydraulic gradient the size of the san grains is critical regarding incipient motion. For turbid water flow over a bed, fine particles of th mixture may become deposited in the bed, resul ing in a more resistant bed. Typical values of th hydraulic gradient are given for flow out of a can and in an ocean bed under oscillatory waves. (K napp-USGS)
W70-10251

SEDIMENT SAMPLING IN AUSTRALIA.
Australian Water Resources Council, Canberra.

Australian Water Resources Council Hydrologica Series No 3, 1969. 47 p, 2 fig, 214 ref, 6 append.

Descriptors: *Sedimentation, *Sampling, *Mea surement, *Sediments, Sediment transport Foreign research, Sediment load, Sedimentatio rates, Sediment yield, Bed load, Suspended load Data collections.
Identifiers: *Australia.

Recommendations are given for methods of col lecting data on sediments in streams and reservoir in Australia. There are areas where rates of erosion are serious, and sediment problems are widespread throughout the country even in areas which are re garded as relatively stable. The methods of data collection and techniques of analysis now used by

water resources organizations in Australia in the fields of suspended sediment transport, bed load transport, and reservoir sedimentation are reviewed. Very little data is being collected in Australia, and the amount and quality varies considerably throughout the country. Nuclear density probes have been used widely for the measurements of in-situ sediment density and there is scope for their use in Australia. Information collected from representative basins should be supplemented by sampling from a number of larger catchments. The total network of sediment measuring stations should be at least 200, and should be established by taking sediment records at approximately 1 in every 15 stream gaging stations. Systematic measurement should be made of reservoir sedimentation. There is a need for the continuous automatic measurement and recording of the sediment concentration in rivers. The data available should be published every five years on a national basis. (Knapp-USGS)
W70-10255

COASTAL EROSION IN NORTH CAROLINA,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering; and Clemson Univ., S. C. Dept. of Civil Engineering.
Leonard J. Langfelder, Donald B. Stafford, and Michael Amein.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW 2, Paper 7306, p 531-545, May 1970. 15 p, 4 fig, 2 tab, 14 ref.

Descriptors: *Beach erosion, *Coasts, *North Carolina, Beaches, Erosion, Waves (Water), Ocean waves, Computer programs, Littoral drift, Mathematical models, Aerial photography, Refraction (Water waves).
Identifiers: Cape Hatteras (N C).

Aerial photography and wave refraction procedures were used to study coastal erosion along the entire 330 miles of the North Carolina coast. The aerial photography method made use of measurements made at 1,400 selected stable measuring points on photographs that were taken as early as 1938. The wave refraction method made use of a computer program to obtain the refracted directions of selected incoming waves. The longshore wave energy was then converted to littoral drift through the use of an empirical equation. The results of both methods indicate the general trend in erosion. Erosion caused by major storms is a significant portion of the total erosion. This storm-induced erosion is included in the results of the aerial photography method but has only a small influence on the results of the wave refraction method. (Knapp-USGS)
W70-10265

STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS IN THE SOUTHERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana.
J. A. Lineback, N. J. Ayer, and D. L. Gross.
Illinois Geological Survey Environmental Geology Notes, Note No 35, August 1970. 35 p, 6 fig, 15 ref, append.

Descriptors: *Bottom sediments, *Lake Michigan, *Illinois, Stratigraphy, Glacial drift, Lakes, Sands, Silts, Clays, Mud, Bottom sediments.
Identifiers: Lake Michigan sediments.

Unconsolidated sediments of late Pleistocene age in southern Lake Michigan can be divided into two major lithologic units. The upper unit is dominantly lacustrine clay of high water content that is soft and variably fossiliferous. The lower unit consists of compact sandy sediments of glacial origin. The upper unit was deposited after the direct influence of the last glacier was felt in southern Lake Michigan. Underlying is a series of glacial-lacustrine deposits, including sand, sandy pebbly clay, silt, and clay-pebble conglomerate. They show the direct effect of nearby glaciers. (Knapp-USGS)
W70-10274

EROSION, RUNOFF, AND REVEGETATION OF DENUDED CONSTRUCTION SITES,
Agricultural Research Service, Lafayette, Ind. Soil and Water Conservation Research Div.; and Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
For primary bibliographic entry see Field 04D.
W70-10280

SEDIMENTATION IN THE FOREDELTA OF THE VOLGA RIVER,
Astrakhan State Reservation (USSR).
Ye. F. Belevich.
Translated from Okeanologiya, Vol 9, No 6, 1969. Oceanology, Vol 9, No 6, p 808-816, 1969. 2 fig, 1 tab, 15 ref.

Descriptors: *Sedimentation, *Deltas, *Water level fluctuations, Deposition (Sediments), Sedimentary structures, Sediments, Sediment transport, Streamflow.
Identifiers: Volga River.

The foredelta of the Volga River has a smooth, but fairly complex bottom relief and represents the transition zone (35-60 km x 200 km) from the above-water delta to the deeper part of the Volga mouth area. Sedimentation in the foredelta occurs under the influence of drift and discharge currents, waves, the inflow of sediments, water level oscillations, and the development of vegetation. Three major types of deposits form: alluvial, made up of slightly modified alluvial sediments; marine, consisting of silt and shells, worked over many times by currents or swash; and residual deposits, formed as a result of the erosion of bottom deposits. Residual deposits are specific features of modern foredeltas. (Knapp-USGS)
W70-10281

QUANTITATIVE DISTRIBUTION OF SUSPENDED MATTER IN THE CENTRAL AND SOUTHEASTERN PARTS OF THE BALTIC SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
O. S. Pustel'nikov.
Translated from Okeanologiya, Vol 9, No 6, 1969. Oceanology, Vol 9, No 6, p 816-827, 1969. 4 fig, 4 tab, 24 ref.

Descriptors: *Suspended load, *Oceans, *Sediments, *Sampling, Geology, Provenance, Nutrients, Silts, Particle size, Surveys, Data collections, Mapping.
Identifiers: Baltic Sea, USSR.

The distribution of suspended matter in the Baltic Sea water was examined. From a study of 317 samples (from 149 stations), collected on a filter with 0.5 micron pores, it was found that the maximum concentrations of suspended matter (1.1-12.4 mg/liter) are confined to regions near abrasion coasts and the mouths of straits. Increased concentrations of suspended matter in the open sea are produced by organisms. The minimum content of suspended matter was found in the layer from 30 to 120 m. Concentration increased markedly again at the bottom. (Knapp-USGS)
W70-10282

ORGANIC MATTER OF RECENT SEDIMENTS OF THE CASPIAN SEA,
Institute of Geology and Fuel Mineral Processing, Moscow (USSR).
O. K. Bordovskiy.
Translated from Okeanologiya, Vol 9, No 6, 1969. Oceanology, Vol 9, No 6, p 799-807, 1969. 6 fig, 3 tab, 11 ref.

Descriptors: *Bottom sediments, *Organic matter, Asphalt, Bituminous materials, Humus, Humic acids, Silts, Clays, Sampling.
Identifiers: Caspian Sea.

The distribution and composition of the organic matter of recent Caspian sediments are discussed. The carbon concentration increases with the degree of dispersion of the sediments and reaches a maximum in clayey silts of the deep water basins of the middle and southern Caspian. The degree of bituminization of organic matter is inversely proportional to the concentration of organic carbon. In the group composition of bitumens, asphaltenes (average 47.2%) and tars (37.4%) predominate. The content of oils averages 14%. Methane-naphthene hydrocarbons predominate in the composition of the oil fraction (60-70%). The amount of aromatic hydrocarbons is 3-10%. A nearly linear relationship is observed between bitumens and humic acids. (Knapp-USGS)
W70-10283

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION 1966-1968, UNITED STATES AND CANADA.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-10318

SOME PRINCIPLES OF FOREST HYDROLOGY PERTINENT TO EVEN-AGED MANAGEMENT OF EASTERN HARDWOODS,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04C.
W70-10421

LAMPREY V AMERICAN HOIST AND DERRICK CO (TITLE TO ACCRETION).

266 NW 434-441 (Minn 1936).

Descriptors: *Minnesota, *Land forming, *Accretion (Legal aspects), *Land tenure, Permits, Leases, Reliction, Landfills, Shores, Boundary disputes, Mississippi River, Riparian rights, Riparian land, Public rights, Easements, Navigable rivers, Navigable waters, Judicial decisions, Legal aspects, Access routes.

Predecessors of plaintiffs owned land bounded on the north by the Mississippi River. Between the river and the lots in contest was a dedicated street. The lots, platted with the river as their northerly boundary, were conveyed by plaintiffs' predecessor to defendant. Since that time, land had been created north of the old river line by accretion. Plaintiffs contended that their predecessors retained a fee in the northern half of the dedicated street, any land then existing north of the street and any land added thereto by accretion or reliction. The court, in affirming a judgment for defendant, ruled that the lots conveyed were in fact bounded by the river. Defendant, after purchasing the lots, could well assume that there was nothing between such lots and the river to interfere with or prevent his free access from his lots to the river. Plaintiffs' predecessors conveyed all their interest in the street and the land and the riparian rights attached thereto when they sold their lots, and defendants took such rights subject only to the public easement in the street. (Price-Florida)
W70-10482

2K. Chemical Processes

MEASUREMENT OF THE MOLECULAR SIZE OF A SODIUM HUMATE FRACTION,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02G.
W70-10074

AUTOMATION OF ATOMIC ABSORPTION ANALYSES,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07B.
W70-10089

DROPLET FREEZING BY SURFACE NUCLEATION,
State Univ. of New York, Albany.

For primary bibliographic entry see Field 02C.
W70-10091

OXYGEN-18 AND TRITIUM IN THE EVIAN BASIN (FRENCH),
Geodynamics Investigation Center, Paris (France).
J. C. Fontes, and R. Letolle, Ph. Olive, and B. Blavoux.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/28, p 401-415, 1967. 15 p, 6 fig, 4 tab, 10 ref.

Descriptors: *Stable isotopes, *Tritium, *Water chemistry, *Groundwater movements, *Groundwater basins, Tracers, Radioactive dating, Tracking techniques, Radioactivity techniques, Water analysis, Water levels, Hydrogeology.
Identifiers: France, Evian Basin.

Isotopic surveys of the Evian basin (precipitation, surface system, test wells and springs) have been going on since 1962. Measurement of oxygen-18 and tritium content have made it possible to determine the mean height of the drainage area and to consider various hypotheses in connection with the hydrodynamics of the water table. It has also been possible to determine the behavior of recent meteoric water and its possible contribution to the water-table supply. The data derived from hydrological studies are in good agreement with the set of isotopic results. The isotopic measurements have also been used to plan the catchment area equipment and to fix the test-well sites. In view of the theoretical and even economic importance of such coordinated isotopic studies, it is proposed that systematic sampling be organized on an international scale on the site on the main catchment areas presenting serious hydrogeological problems. (Knapp-USGS)
W70-10095

SOIL-WATER MOVEMENT AND EVAPOTRANSPIRATION: CHANGES IN THE ISOTOPIC COMPOSITION OF THE WATER,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
U. Zimmermann, D. Ehhalt, and K. O. Munnich.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/38, p 567-585, 1967. 19 p, 17 fig, 1 tab, 17 ref.

Descriptors: *Soil water movement, *Evapotranspiration, *Tracers, *Deuterium, *Tritium, Evaporation, Transpiration, Tracking techniques, Groundwater movement, Stable isotopes, Radioisotopes, Water chemistry.
Identifiers: Isotopic concentration.

An artificial rainfall spiked with tritium may be used to estimate the amount of rain fallen after the date of tracer input. Dispersion is usually combined with a scatter in the position of the tracer maximum in parallel cores. Among recent improvements in sample processing is newly developed equipment to distill six samples simultaneously. The change in stable isotope composition of the soil water during downward movement has also been studied in detail. Experiments show that plant transpiration results in practically no isotopic enrichment of soil water. The considerable average velocity with which the water moves upward from the root to the leaves makes this possible despite heavy enrichment of the water in the leaves. Under central European conditions a bare soil may, however, show a deuterium enrichment up to about 20% in the top layers. It is obvious that evaporation from the soil, and therefore enrichment, is strongly suppressed by plant cover, espically during summer. A bare soil under the same conditions as a planted one showed, in a number of measurements, deuterium enrichment of about 10% more than the average amount. With the help of information obtained by tracer experiments on the seasonal variation of groundwater recharge it is now possible to explain the absolute value found for the deuterium content of Central European groundwater. (Knapp-USGS)
W70-10104

THE RELATIONSHIP BETWEEN DISSOLVED NUTRIENT SALTS AND PROTEIN PRODUCTION IN SUBMERGED AUTUMNAL LEAVES,
Waterloo Univ. (Ontario).
H. B. N. Hynes, and N. K. Kaushik.
Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 95-103, 1969. 3 tab, 17 ref.

Descriptors: *Proteins, *Productivity, *Submerged plants, *Autumn, *Leaves, Organic matter, Aquatic environment, Ecosystems, Nitrogen, Oak trees, Temperature, Phosphates, Decomposing organic matter, Benthic fauna, Maple trees.
Identifiers: *Dissolved nutrient salts, Ulmus americana, Alnus rugosa, Quercus alba, Speed River (Ontario), Hyalella azteca, Microbial activity, Beech, Gammarus lacustris limnaeus, Asellus aquaticus.

Autumn-shed leaves are known to constitute a substantial portion of the ecologically important allochthonous organic matter accumulating in aquatic ecosystems. A study was made to determine whether leaves kept submerged in water and provided with varying quantities of nitrogen from different sources show changes in their nitrogen and protein contents, and whether there is any increase in the absolute quantity of nitrogen. Autumn-shed leaves of elm, alder, and oak were analyzed and changes in mean pecentage weight lost and in protein and nitrogen contents of the elm leaf discs subjected to different treatments are tabulated. Both at 10C and at 20C-22C, the addition of nitrogen to the water in ammonium sulfate form or potassium nitrate enhanced percentage weight lost as compared with controls. Weight loss was generally more pronounced with the addition of phosphate or when the water was enriched with organic nitrogen (Hyalella azteca). As expected, weight loss was accelerated at higher temperatures. The greatest loss of percentage weight was consistently found in elm leaves, and the lowest in alder. Decay rates obviously must be in some way correlated with initial composition. (Jones-Wisconsin)
W70-10163

ANNUAL CYCLE OF PHYTOPLANKTON AND OF PRIMARY PRODUCTION IN TROPICAL SEAS (IN FRENCH),
Museum National d'Histoire Naturelle, Paris (France). Laboratoire des Peches Outre-Mer.
A. Sournia.
English abstract. Marine Biology, Vol 3, No 4, p 287-303, 1969. 5 fig, 125 ref.

Descriptors: *Phytoplankton, *Primary productivity, *Neritic, *Oceans, Sea water, Gulfs, Hydrologic aspects, Climates, Seasonal, Atlantic Ocean, Indian Ocean, Pacific Ocean, Salinity, Temperature, Tropical regions.
Identifiers: Annual cycles, Tropical seas, Brazilian coast, Caribbean Sea, Gulf of Mexico, Bahamas, Sargasso Sea, Gulf of Mannar, Madagascar coast.

Voluminous literature is reviewed describing biotic features of southern seas delineated by the minimum isotherms of 22C throughout the year. By far the larger part of information is confined to the 'neritic' or 'sea' waters, rather than waters of the oceans. In the neritic waters an annual cycle of the composition and intensity of the primary production is usually observed; the seasonal variations are related to the influence of current, upwelling, and climatic factors, especially monsoons. Information on oceanic waters is too meager to permit generalizations. (Wilde-Wisconsin)
W70-10172

THE QUALITY OF ARIZONA'S DOMESTI AGRICULTURAL, AND INDUSTRIA WATERS,
Arizona Univ., Tucson. Agricultural Experime Station.
For primary bibliographic entry see Field 05A.
W70-10224

QUANTITY AND CHEMICAL QUALITY O LOW FLOW IN THE PRAIRIE DOG TOW FORK RED RIVER NEAR WAYSIDE, TEXA FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-10229

SOUTHERN MARYLAND RECORDS O SELECTED WELLS, WATER LEVELS, AN CHEMICAL ANALYSES OF WATER,
Geological Survey, Towson, Md.
For primary bibliographic entry see Field 04B.
W70-10231

COMPARISON OF CHEMICA HYDROGEOLOGY OF THE CARBONAT PENINSULAS OF FLORIDA AND YUCATAN,
Geological Survey, Washington, D.C.
William Back, and Bruce B. Hanshaw.
Journal of Hydrology, Vol 10, No 4, p 330-36 June 1970. 39 p, 15 fig, 5 tab, 28 ref.

Descriptors: *Geochemistry, *Hydrogeolog *Water chemistry, *Florida, Groundwate Aquifers, Leaching, Infiltration, Recharg Discharge (Water), Saline water-freshwater inte faces, Saline water intrusion, Groundwater mov ment.
Identifiers: Yucatan.

Aquifers of the peninsulas of Florida and norther Yucatan are Tertiary marine carbonate formation showing many lithologic and faunal similarities. I addition, the tropical to subtropical climates of th two areas are similar, each having annual rainfall c about 1000 to 1500 mm. Despite similarities i these fundamental controls, contrasts in th hydrologic and geochemical systems are numerou and striking. For example, Florida has many rivers Yucatan has none. In Florida, the chemica character of water changes downgradient, wit solution of minerals of the aquifer; in the Yucata no downgradient change exists, and dominan processes controlling the chemical character of th water are solution of minerals and simple mixing o the fresh water and an underlying body of sal water. The differences are due primarily to the lack in Yucatan of an upper confining bed hydrologi cally equivalent to the Hawthorn Formation o Florida. The Hawthorn cover impedes recharg and confines the artesian water. In the Yucatan the permeability of the entire section is so great tha rainfall immediately infiltrates to the water table and then moves laterally to discharge areas along the coasts. (Knapp-USGS)
W70-10232

FOSSIL WATER,
Geological Survey, Woods Hole, Mass.
F. T. Manheim.
Oceanus, Vol 15, No 4, p 30-32, July 1970. 3 p, 2 fig.

Descriptors: *Bottom sediments, *Salinity, Cores, Chemical analysis, On-site investigations, Ships, Cruises.
Identifiers: *Black Sea, *Fossil water, Pressed water, Sediment profile.

Chemical analyses were made from water pressed from sediment cores collected from the Black Sea during the scientific data-collecting cruise aboard the R. V. Atlantis II in April and May 1969. Salinity, alkalinity, phosphate, nitrate, ammonia, nitrite, and silicate determinations were made immediately, and other samples were fused in polyethylene pipe or in glass ampules and saved for later detailed

analysis in the laboratory. The work done on board revealed that pore fluids become less salty with depth over nearly the entire Black Sea, probably because of the influence of fresher waters incorporated in the sediments during the glacial periods. The only exception to this occurs on approaching the Bosporus, where salinities decrease less and less with depth. A map showing the 'fossil' chlorinity of the Black Sea sediments at a depth of two meters below the seabottom is included. (Woodard-USGS)
W70-10234

LITHOLOGIC CONTROLS ON THE DEVELOPMENT OF SOLUTION POROSITY IN CARBONATE AQUIFERS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 02F.
W70-10250

THE POISONING OF ION EXCHANGE MATERIALS BY SURFACE ACTIVE IONS,
Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 03A.
W70-10260

HYDROGEN BONDING AND POLYWATER IN CLAY-WATER SYSTEMS,
Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
For primary bibliographic entry see Field 01A.
W70-10278

ORGANIC MATTER OF RECENT SEDIMENTS OF THE CASPIAN SEA,
Institute of Geology and Fuel Mineral Processing, Moscow (USSR).
For primary bibliographic entry see Field 02J.
W70-10283

ELECTROPHORETIC CLARIFICATION OF WATER,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 05D.
W70-10314

NUTRIENT REGENERATION IN LAKES AND OCEANS,
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-10404

2L. Estuaries

PHYSICAL AND MATHEMATICAL MODEL STUDIES OF SURFACE CURRENTS,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 05G.
W70-10206

MATHEMATICAL MODEL TECHNIQUES FOR COASTAL WATERS,
Edinburgh Corp. (Scotland).
For primary bibliographic entry see Field 05G.
W70-10207

ACTIVABLE RARE EARTH ELEMENTS ESTUARINE WATER TRACERS,
Stanford Univ., Calif. Dept. of Civil Engineering; and Public Health Service San Francisco, Calif.
For primary bibliographic entry see Field 05A.
W70-10210

COMPARISON OF CHEMICAL HYDROGEOLOGY OF THE CARBONATE PENINSULAS OF FLORIDA AND YUCATAN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02K.
W70-10232

BOUNDARY SHEAR STRESS IN RIVERS AND ESTUARIES,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-10257

SEDIMENTATION IN THE FOREDELTA OF THE VOLGA RIVER,
Astrakhan State Reservation (USSR).
For primary bibliographic entry see Field 02J.
W70-10281

QUANTITATIVE DISTRIBUTION OF SUSPENDED MATTER IN THE CENTRAL AND SOUTHEASTERN PARTS OF THE BALTIC SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02J.
W70-10282

ESTUARINE CLEAN WATER COST-BENEFIT STUDIES,
International Water Pollution Research Conference (5th).
For primary bibliographic entry see Field 05G.
W70-10373

ESTUARINE MEASUREMENTS FOR PRODUCTIVITY AND EVALUATION OF SYSTEM WASTE DISCHARGE EFFECTS,
Texas Univ., Austin.
For primary bibliographic entry see Field 05C.
W70-10401

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SIMULATION-DECISION AID IN PLANNING DESALTING APPLICATIONS,
Office of Saline Water, Washington, D.C.
John S. Westrope.
Water Resources Bulletin, Vol 6, No 4, p 602-616, July-August 1970. 15 p, 7 fig, 1 tab.

Descriptors: *Simulation analysis, *Water resources development, *Desalination, *Systems analysis, *Optimization, Water management (Applied), Computer programs, Economics, Water costs, Conjunctive use, Mathematical models, Digital computers.
Identifiers: Office of Saline Water.

A simulation system under development is a highly flexible computerized model system for evaluating real economic/technical applicability of desalting to a selected area. The Economic Evaluation Model System (EEMS) was initially conceived during 1968 and the first version was completed in 1969. This system represents the combination of technical, environmental and economic functions into an interrelated system, which allows the user to examine a broad range of water related problems, oriented toward the applicability of desalting as an additional or alternative source of water. (Knapp-USGS)
W70-10075

DEVELOPMENT STUDIES ON THE FLASH DISTILLATION PROCESS,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
R. A. Tidball, A. N. Rogers, and R. N. Webb.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C, 20402, Price $0.75. US Office of Saline Water Research and Development Progress Report No 562, May 1970. 79 p, 24 fig, 15 tab, 10 ref, 2 append. OSW Contract No 14-01-0001-1279.

Descriptors: *Desalination processes, *Flash distillation, Thermodynamics, Scaling, Pilot plants, Desalination plants, Testing, Research and development.
Identifiers: Multistage Flash Distillation.

Two flash distillation pilot plants were operated at the OSW Test Station: (1) a 16-stage High-temperature Flash Distillation Plant; (2) a 3-stage High-flow Flash Devices Test Plant. In the 16-stage plant, scale formation is given over a range of operating conditions as well as with scale control additives. In addition, preliminary tests were made on ion exchange, fluidized bed, and slurry seeding processes. The 3-stage plant tests cover the simple open interstage orifice under a wide range of operating conditions, plus several of the more promising flash enhancers. Graphs relate non-equilibrium values to the various operating parameters. (Knapp-USGS)
W70-10082

VACUUM-FREEZING VAPOR-COMPRESSION PROCESS: EVALUATION ON BRACKISH WATER,
Fairbanks, Morse and Co., Beloit, Wis.
M. M. Jhawar, and J. H. Fraser.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $0.65. U S Office of Saline Water Research and Development Progress Report No 541, March 1970. 46 p, 16 fig. OSW Contract No 14-01-0001-967.

Descriptors: *Desalination processes, *Pilot plants, *Freezing, Saline water, Sea water, Potable water, Scaling, Chemical precipitation, Water chemistry, Water yield, Water costs.
Identifiers: Vacuum-freezing, Vapor-compression desalination.

The Vacuum-Freezing Vapor-Compression (VFVC) Process was evaluated on high salinity brackish water during the period from February 1968 through December 1969 at Roswell, New Mexico. A 15,000 gpd VFVC test plant is mounted on a mobile trailer. The system was checked out and the unit was operated sucessfully on sea water. In Roswell, tests were conducted to determine the effects of precipitation and scaling on the VFVC Process. A number of tests were carried out with yields of 20% to 80%, and the effluent brine concentration ranging from 2.13% to 8.0%. In the entire range, no significant evidence of precipitation or scaling was noticed. No difficulty was encountered in making 500 ppm potable water. The fresh water had a natural taste. (Knapp-USGS)
W70-10083

STUDY OF SEAWATER DESALTING AS EMERGENCY WATER SUPPLY FOR NEW YORK CITY.
Parsons-Jurden Corp., New York.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $2.50. U S Office of Saline Water Research and Development Progress Report No 553, January 1970. 273 p, 57 fig, 18 tab, 73 ref, 2 append. OSW Contract No 14-01-0001-1712.

Descriptors: *Desalination plants, *Design, *New York, Cities, Water supply, Droughts, Water shortage, Water sources, Desalination, Sea water, Water utilization, Municipal water, Urbanization, Water requirements, Water resources development.
Identifiers: *New York City.

The problems involved in the application of desalting to meet the emergency and supplemental water needs of the individual boroughs of the City of New York are discussed. The criteria and controlling factors to be considered in the selection of a suita-

ble site are listed, and conceptual designs for 5-, 10- and 25 MGD module desalting plants are presented. A plant design of a size sufficient to meet the requirements of emergency and supplemental water needs was developed. An economic analysis is made of the costs of product water for 5-, 10- and 25 module plants. Although this report is oriented directly around the requirements of the individual boroughs of New York City, the developed information may be applied to evaluating the feasibility of using the distillation plant for meeting the requirements of a major subdivision of any other metropolitan area. (Knapp-USGS)
W70-10084

DISPOSAL OF BRINE BY SOLAR EVAPORATION: DESIGN CRITERIA,
New Mexico State Univ., Las Cruces.
For primary bibliographic entry see Field 05E.
W70-10085

SALINE GROUNDWATER RESOURCES OF THE RIO GRANDE DRAINAGE BASIN--A PILOT STUDY.
Geological Survey, Albuquerque, N. Mex.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $2.00. U S Office of Saline Water Research and Development Progress Report No 560, May 1970. 71 p, 21 fig, 1 tab, 21 ref. OSW Agreement No 14-01-0001-2102.

Descriptors: *Saline water, *Water resources development, *Groundwater, *Texas, *New Mexico, Desalination, Water sources, Hydrogeology.
Identifiers: Saline groundwater.

The saline groundwater resources of the Rio Grande drainage basin of Colorado, New Mexico, and Texas were evaluated for the potential application as feed water for desalting plants. The occurrence of groundwater in the basin is controlled primarily by geologic structure, and secondarily by the stratigraphy and lithology of the aquifers. The Albuquerque, New Mexico, and Brownsville, Texas areas are underlain by aquifers that yield more than 500 gpm of saline water of about 3 g/liter salinity from individual wells. The top of this water-quality unit is approximately 3,000 feet below the land surface at Albuquerque, and 1,500 feet or less at Brownsville. The Capitan reef complex in New Mexico and Texas also would sustain large yields of water. More than 6,500 square miles of the lower Rio Grande, Estancia, Jornada del Muerto, and upper Pecos drainage basins are underlain by water of 10-35 g/liter salinity. Brine, containing more than 35 g/liter dissolved solids, is available in significant quantities in the Tularosa basin. A bibliography containing 273 entries is included. (Knapp-USGS)
W70-10086

RESEARCH AND DEVELOPMENT OF NEW AND IMPROVED CELLULOSE ESTER MEMBRANES,
Aerojet-General Corp., El Monte, Calif.
D. L. Hoernschemeyer, C. W. Saltonstall, O. S. Schaeffler, L. W. Schoellenbach, and A. J. Secchi.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $0.65. U S Office of Saline Water Research and Development Progress Report No 556, August 1970. 63 p, 8 fig, 15 tab, 16 ref, 3 append. OSW Contract No 14-01-0001-2205.

Descriptors: *Membranes, *Membrane processes, *Reverse osmosis, *Desalination apparatus, Desalination processes, Brackish water, Saline water, Thin films.
Identifiers: Cellulose membranes.

Improved brackish-water desalination membranes can be fabricated from cellulose acetate and cellulose acetate methacrylate in a manner very similar to that used to make high retention seawater membranes. All the acetates with a ds between 2.1 and 2.63 can be made to have equivalent osmotic properties. Vastly increased flux, along with greatly improved flux stability has been achieved by cross-linking cellulose acetate methacrylate (CAM) membranes. Salt permeability coefficient is closely related to the cohesive energy of the polymer. (Knapp-USGS)
W70-10087

EVALUATION OF PYRRONES AS MEMBRANES,
Franklin Inst. Research Labs., Philadelphia, Pa.
For primary bibliographic entry see Field 05D.
W70-10125

ANNUAL REPORT (FY 1969) WEBSTER TEST FACILITY AND ELECTRODIALYSIS TEST-BED PLANT, WEBSTER, SOUTH DAKOTA.
Mason-Rust, Louisville, Ky.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $1.50. U S Office of Saline Water Research and Development Progress Report No 568, June 1970. 159 p, 41 fig, 19 tab, 4 ref. OSW Contract No 14-01-0001-1802.

Descriptors: *Pilot plants, *Desalination plants, *Electrodialysis, *Reverse osmosis, Membrane processes, Testing, Research and development, Water costs, Desalination processes, Membranes, Cost analysis, Performance.
Identifiers: Webster (SD), Desalination test-bed facilities.

An electrodialysis Test Bed Plant has completed the seventh year of demonstration and development operation. The plant has a production capacity of 325,000 gallons per day. The electrodialysis plant feed water was pretreated for iron removal by Zeolite filtration. Lime softening plus carbon filtration was also used to pretreat the water to remove iron, manganese, bicarbonate alkalinity, some hardness, and water soluble 'organic' materials. Carbon filtration removes most of the anion permeable membrane fouling agents. Problems associated with membranes such as membrane breakage and anion membrane fouling are responsible for high product water costs. If membrane fouling and breakage were not problems, product water costs would be $0.83 per 1,000 gallons (250,000 GPD, 330 days on stream). Pilot plant development programs at Webster were in: (1) high temperature electrodialysis, (2) evaluation of membranes for electrodialysis and transport depletion, and (3) reverse osmosis. (Knapp-USGS)
W70-10258

FORCED-FLOW ELECTRODESALINATION,
Southern Research Inst., Birmingham, Ala.
Thomas A. Davis, and Robert E. Lacey.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $1.00. U S Office of Saline Water Research and Development Progress Report No 557, July 1970. 93 p, 26 fig, 17 tab, 9 ref, 5 append. OSW Contract No 14-01-0001-1167.

Descriptors: *Electrodialysis, *Desalination processes, Membrane processes, Flow, Boundary processes, Model studies, Mathematical models, Testing, Research and development, Dialysis, Pilot plants, Electrochemistry, Desalination, Membranes.
Identifiers: *Forced-flow electrodesalination.

Forced-flow electrodesalination (FFED) utilizes high-shear flow through thin solution compartments to reduce concentration polarization. In electrodialysis of natural brackish waters, precipitation of pH sensitive salts within the stack as a result of concentration polarization usually limits the operating current density to a value well below the economic optimum current density. With the thin solution compartments and high solution velocities of FFED, high values of limiting current density can be obtained. Cell-pair resistances also lower with the thin solution compartmen Costs of treatment of brackish waters by FFED a estimated to be about 25% less than costs of trea ment by conventional electrodialysis. A system equations was developed to describe the operatic of the FFED stack. With these equations, t operating conditions, energy consumption, an production rate of a given FFED stack can be pr dicted. (Knapp-USGS)
W70-10259

THE POISONING OF ION EXCHANG MATERIALS BY SURFACE ACTIVE IONS,
Dow Chemical Co., Midland, Mich.
Hamish Small, and Robert C. Gardner.
For sale by the Superintendent of Documents, U Government Printing Office, Washington, D 20402 - Price $0.70. U S Office of Saline Wate Research and Development Progress Report N 565, August 1970. 71 p, 22 fig, 4 ref, 2 appen OSW Contract No 14-01-0001-2158.

Descriptors: *Membrane processes, *Desalinatio processes, *Ion exchange, *Surfactants, Mem branes, Permeability, Resins, Semipermeable mem branes, Inhibitors.
Identifiers: Membrane poisoning.

An experimental study was made of how the rate c a simple ion exchange reaction is influenced by th presence of surface active ions in both resin an membrane systems. Ion exchange membran poisoning results from the formation of barrie layers, which are sparsely populated by mobile ca riers, the majority of the sites being occupied b sluggish, tightly bound poison ions. Exposure of io exchanging materials to even very low levels of sur factants can lead to poisoning. Significant poison ing effects were noted when the level of surfactan was about 1/1000 M. Protection for the exchange could be derived by providing for as high a degre of cross-linking as possible. This would tend t prevent the accretion of large poisoning ions in the exchanger purely on a kinetic basis. Alcohols are effective, with their effectiveness increasing a their nonpolar character increases. A nonionic sur face active agent was effective in neutralizing the poisoning effect of surfactants. (Knapp-USGS)
W70-10260

VERTICAL TUBE EVAPORATION UTILIZING VORTEX FLOW AND INTERFACE ENHANCEMENT,
California Univ., Berkeley. Sea Water Conversion Lab.
Hugo H. Sephton.
For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price $0.75. Office of Saline Water, Research and Development Progress Report 574, May 1970. 81 p, 36 fig, 7 ref. OSW Contract 14-01-0001-1744.

Descriptors: *Research and development, *Rising film evaporation, *Falling film evaporation, *Heat transfer improvements, *Vortex tube process, *Interface enhancement process, *Surfactant additives, *Twisted tubes, Proprietary processes, Foaming agents, OSW sponsored investigation.

The purpose of this study is to test pairs of full sized distillation tubes in vertical mode to provide comparative data from upflow and downflow modes of operation. Double-fluted and spiral-corrugated distillation tubes were tested with fresh water, brine and sea water feed in both the upflow and downflow mode. Two novel, proprietary methods of brine side enhancement were applied: the Vortex Tube process and the Interface Enhancement method. The latter method in upflow mode was emphasized in this work. It depends upon the addition of selected surfactants to the feed brine in a few parts per million concentrating and upon establishing a foamy two-phase flow condition over the heat transfer surface. Over-all heat transfer

enhancements of about 100 percent was reproducibly demonstrated under realistic upflow VTE conditions with both double-fluted and spiral-corrugated distillation tubes using sea water feed having 6 ppm of a fully biodegradable commercial surfactant added thereto at a cost of $12 per 1.5 million gallons of sea water treated or 6 cents/1000 gallons. (Pruett-Office of Saline Water)
W70-10317

DEMINERALIZATION OF WASTE WATER BY ION EXCHANGE,
Los Angeles County Sanitation District, Calif.; and Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W70-10400

3B. Water Yield Improvement

OPTIMAL PLANNING OF A COASTAL COLLECTOR,
Technion-Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel-aviv.
For primary bibliographic entry see Field 02F.
W70-10053

OPTIMUM OPERATING PROCEDURE FOR A RIVER GAGING STATION ESTABLISHED TO PROVIDE DATA FOR DESIGN OF A WATER SUPPLY PROJECT,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-10057

EVAPOTRANSPIRATION BY WOODY PHREATOPHYTES IN THE HUMBOLDT RIVER VALLEY, NEAR WINNEMUCCA, NEVADA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02D.
W70-10243

EMPIRICAL RELATIONS IN PROPERTIES OF UNCONSOLIDATED QUARTZ SANDS AND SILTS PERTAINING TO WATER FLOW,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia); and Australian Atomic Energy Commission Research Establishment, Lucas Heights.
For primary bibliographic entry see Field 02F.
W70-10245

STREAMFLOW CHANGES AFTER FOREST CLEARING IN NEW ENGLAND,
Forest Service (USDA), Durham, N. H. Northeastern Forest Experiment Station.
J. W. Hornbeck, R. S. Pierce, and C. A. Federer.
Water Resources Research, Vol 6, No 4, p 1124-1132, August 1970. 9 p, 3 fig, 3 tab, 15 ref.

Descriptors: *Water yield improvement, *Clear-cutting, Forest management, Land clearing, Watershed management, Water yield, Rainfall-runoff relationships, Snowmelt, Hydrograph analysis, Infiltration.
Identifiers: Hubbard Brook Experimental Watershed (NH).

Clearing a hardwood forest cover and preventing regrowth with herbicides on a 39-acre watershed in central New England increased annual water yield an average 12.2 area-inches for the first two water years after treatment. Most of this increase occurred during the critical low flow months of June through September, and the amount was governed in large part by rainfall in this period. There was a small advance of snowmelt runoff and a consistent increase in growing season high flow values. Sizeable streamflow increases can result from forest clearing in the uplands of the eastern United States. (Knapp-USGS)
W70-10249

3C. Use of Water of Impaired Quality

PHYSIOLOGICAL RESPONSES OF PLANTS TO SALINITY: PLANT-WATER RELATIONS,
Arizona Univ., Tucson. Environmental Research Lab.
For primary bibliographic entry see Field 02I.
W70-10306

3D. Conservation in Domestic and Municipal Use

CITY OF CORAL GABLES V CRANDON (CONSTITUTIONALITY OF STATUTE ESTABLISHING WATER CONSERVATION DISTRICTS).
For primary bibliographic entry see Field 06E.
W70-10348

THE FULL-SCALE RECLAMATION OF PURIFIED SEWAGE EFFLUENT FOR THE AUGMENTATION OF THE DOMESTIC SUPPLIES OF THE CITY OF WINDHOEK,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 05D.
W70-10381

3E. Conservation in Industry

SOME ECONOMIC ASPECTS OF WATER REUSE IN CZECHOSLOVAKIA,
International Water Pollution Research Conference (5th).
For primary bibliographic entry see Field 05D.
W70-10372

NIAGARA FALLS POWER CO V FEDERAL POWER COMM'N (DIVERSION OF WATER FROM RIVER BY POWER COMPANY).
For primary bibliographic entry see Field 06E.
W70-10458

3F. Conservation in Agriculture

LINEAR PROGRAMMING MODELS FOR ESTIMATING THE AGRICULTURAL DEMAND FUNCTION FOR IMPORTED WATER IN THE PECOS RIVER BASIN,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 06D.
W70-10055

FACTORS AFFECTING DETERMINATION OF IRRIGATION WATER REQUIREMENTS,
California State Dept. of Water Resources, Sacramento.
John W. Shannon, and Norman MacGillivray.
7th Congr Irrig Drain, Quest 23, Rep Disc, Part 2, R24-R45, Mexico City, p 23.559-23.568, 1969. 11 p, 2 fig, 1 tab, 8 ref.

Descriptors: Irrigation, *Water requirements, Evapotranspiration, Soil moisture, Consumptive use, Crops, Root systems, Root zone, Forecasting, Plant physiology, *Irrigation efficiency, *Irrigation water, Estimating, *Irrigation operation and maintenance, *Irrigation practices, Roughness, Climates.
Identifiers: *Irrigation requirement, Ground cover, Tulare Lake Basin, Calif, Soil moisture storage, California Department of Water Res.

The California Department of Water Resources is conducting field studies to obtain data upon which reasonable estimates of irrigation water requirements may be based. Observations and data collected in the valley floor portion of the Tulare Lake Basin typify results obtained state-wide and are used to illustrate factors considered in estimating irrigation requirements. Although considerable emphasis has been placed on precise determination of evapotranspiration in research studies throughout the world in recent years, other factors of equal importance that have been neglected are: storage and use of available soil moisture accruing from rainfall and irrigation, and actual and achievable irrigation efficiencies. While these factors are interrelated, some physical factors influencing them are discussed in the light of Department of Water Resources field studies. The approach for estimating irrigation water requirements, in which all the above-listed factors are considered, is based upon a soil moisture-budgeting procedure. An example illustrates how one crop, having a deeper rooting pattern, may use excess moisture that was applied to a preceding shallow-rooted crop. (USBR)
W70-10134

ULTRASONIC FLOWMETER,
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 04A.
W70-10139

IRRIGATION REQUIREMENTS FROM EVAPORATION,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02D.
W70-10141

AUTOMATIC MECHANICAL IRRIGATION GATES,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.
For primary bibliographic entry see Field 08C.
W70-10145

POST-IRRIGATION MOVEMENT OF SOIL WATER 2. SIMULTANEOUS REDISTRIBUTION AND EVAPORATION,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02G.
W70-10247

WATER RELATIONS OF MAIZE: PART 1. - EFFECTS OF SEVERE SOIL MOISTURE STRESS IMPOSED AT DIFFERENT STAGES OF GROWTH ON GRAIN YIELDS OF MAIZE,
Rhodesia Dept. of Research and Specialist Services, Salisbury.
J. H. Wilson.
Rhodesian Journal of Agricultural Research, Vol 6, No 2, p 103-105, 1968. 2 tab, 3 ref.

Descriptors: *Corn (Field), *Growth stages, *Moisture stress, *Crop response, *Crop production, Drought, Arid lands, Semiarid climates, Soil moisture, Soil water, Irrigation, Irrigation effects, Environmental effects, Plant physiology, Plant growth, Flowering, Leaves, Grains (Crops), Soil-water-plant relationships.
Identifiers: *Rhodesia, Soil matric potential.

A study was undertaken at Salisbury, Rhodesia, in which corn was grown outdoors in soil-filled polyethylene bags. Rainfall influence on the study was prevented by clamping the bags around the base of the stalk. Irrigation held the soil matric potential above -2.0 atm except during 5 stages of growth or various combinations of these stages. At such time, irrigation was withheld and severe soil moisture stress developed until soil matric potential fell below -15.0 atm for 8 days. These drought periods occurred at the eight leaf stage, silking, and early, middle, and late grain-development stages. Drought before flowering lengthened the duration of leaves, but drought after flowering caused premature leaf aging. Number of grains per plant was reduced by up to 32 percent if drought occurred between late vegetative and early grain development stages and by up to 49 percent if drought came after flowering. Two or more consecutive

droughts during the late vegetative and early reproductive phases caused as much as 66 percent yield reduction. (See also W70-10290) (Carr-Arizona)
W70-10289

WATER RELATIONS OF MAIZE: PART 2. - THE EFFECTS OF NINE IRRIGATION REGIMES ON MAIZE,
Rhodesia Dept. of Research and Specialist Services, Salisbury.
J. H. Wilson.
Rhodesian Journal of Agricultural Research, Vol 6, No 2, p 107-108, 1968. 2 tab, 1 ref.

Descriptors: *Corn (Field), *Growth stages, *Moisture stress, *Crop response, *Crop production, Drought, Arid lands, Semiarid climates, Soil moisture, Irrigation, Irrigation effects, Environmental effects, Soil water, Plant physiology, Plant growth, Flowering, Leaves, Grains (Crops), Soil-water-plant relationships.
Identifiers: *Rhodesia, Soil matric potential.

Corn was grown in Rhodesia under wet, medium, and dry soil water regimes. Under these regimes, soil matric potential was allowed to fall to -2.0, -15.0, and less than -15.0 atm, respectively, before irrigation. Varying combinations of regimes were imposed, one before and one after silking. Drought before flowering delayed tasselling and silking and caused a decrease in number of grain. However, water regime before flowering was not nearly so important as water regime after flowering. As long as plants were well watered after flowering, heavier grain compensated for any decrease in number of grain. Leaves endured longer if watered infrequently before flowering and generously afterwards. In contrast, leaf aging was 3 to 4 weeks premature when plants were watered sparingly during the reproductive phase. (See also W70-10289) (Carr-Arizona)
W70-10290

EFFECTS OF SIMULATED GRAZING ON SOIL MOISTURE CONTENT IN MID-ELEVATION RESEEDED RANGELAND,
Utah State Univ., Logan.
John C. Buckhouse, and George B. Coltharp.
Utah Academy of Sciences, Arts, and Letters, Proceedings, Vol 45, pt 1, p 211-219, 1968. 3 fig, 4 tab, 9 ref.

Descriptors: *Grazing, *Range management, *Soil moisture, *Moisture content, *Water yield, Semiarid climates, Livestock, Ranges, Carrying capacity, Grasslands, Forages, Alfalfa, Wheatgrasses, Water conservation, Utah.
Identifiers: *Simulated grazing, *Grazing effects, *Reseeding.

In 1966 and 1967 a range plant clipping study was undertaken on an established stand of crested wheatgrass (Agropyron cristatum) and alfalfa (Medicago sativa) at Major's Flat, Utah. In 1965 27 circular plots were fenced and randomly assigned to one of 9 treatment schemes. Soil moisture on each plot was measured by a neutron meter through a soil moisture access tube. The study showed that, when compared with control conditions, significantly less soil moisture was withdrawn under extreme clipping treatments. Less intense clipping also resulted in reduced soil moisture withdrawal, although occasionally the differences were not statistically significant. On mid-elevation ranges heavy grazing apparently increases water yield, but such problems as flooding and decreased water quality may occur. This would seem to indicate that forage removal between the extremes of control conditions and complete denudation would yield the most benefits of increased livestock use and increased water yield. However, until the effects of trampling are studied, direct implications cannot be drawn between this experiment and absolute soil moisture response to livestock grazing. (Carr-Arizona)
W70-10291

A HYDROLOGIC BUDGET FOR A SOUTHERN ALBERTA IRRIGATION DISTRICT,
Department of Agriculture, Lethbridge (Alberta). Research Station; and Alberta Univ., Edmonton. Dept. of Agricultural Engineering.
E. Rapp, J. C. van Schaik, and N. N. Khanal.
Canadian Agricultural Engineering, Vol 11, No 2, p 54-57, November 1969. 2 fig, 3 tab, 11 ref.

Descriptors: *Hydrologic budget, *Hydrologic data, *Irrigation water, *Irrigation districts, *Water distribution (Applied), Water management (Applied), Analysis, Semiarid climates, Irrigation, Irrigation programs, Irrigation efficiency, Irrigation practices, Efficiencies, Water requirements, Diversion, Precipitation (Atmospheric), Water conveyance, Consumptive use, Diversion losses, Water loss.
Identifiers: *Alberta (Canada), *Bow River Project, Gross diversion, Farm losses, Irrigation factor, Conveyance efficiency.

The Vauxhall District of the Bow River Project in Southern Alberta, Canada, was studied from 1958 to 1968 in order to obtain data on the various components of a hydrologic budget for the area. During the 10-year study period, gross diversion was 74% and seasonal precipitation was 26% of the total items of supply. On the other side of the budget, consumptive water requirement was 54%, diversion losses 26%, and farm losses 20%. These figures yielded an average irrigation factor of 63%, water conveyance efficiency of 65%, farm irrigation efficiency of 58%, and overall efficiency of 38%. Highly significant correlations were obtained between seasonal rainfall and irrigation factor, between seasonal rainfall and gross diversion per irrigable acre, and between gross diversion and farm and diversion losses. Data analysis such as this is useful when assessing water allocation or estimating water needs on existing or proposed irrigation projects. (Carr-Arizona)
W70-10298

THE ECOLOGICAL BACKGROUND TO LAND-USE STUDIES IN TROPICAL AFRICA, WITH SPECIAL REFERENCE TO THE WEST,
Birmingham Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 02I.
W70-10309

POPULATION DENSITY AND AGRICULTURAL SYSTEMS IN WEST AFRICA,
Salford Univ. (England). Dept. of Geography.
M. B. Gleave, and H. P. White.
In: Environment and Land Use in Africa, Chapter 10, p 273-299, Methuen, London, 1969. 2 tab, 70 ref.

Descriptors: *Land use, *Fallowing, *Cultivation, *Population, *Economic efficiency, Grazing, Social impact, Social values, Tropical regions, Semiarid climates, Ecology, Rain forests, Grasslands, Agriculture, Land management, Density.
Identifiers: *West Africa, *Intensive agriculture, *Extensive agriculture, *Agricultural evolution.

The effects of increasing African populations are explored in relation to their impacts on existing agricultural systems. In West Africa, 3 types of agriculture and their corresponding social effects may be distinguished: (1) shifting agriculture, occurring in relatively arid areas of low population densities and characterized by long periods of bush fallow and periodic land redistribution by the clan or family group; (2) rotational bush fallowing where land and water rights are maintained by the family or individual; (3) semi-permanent cultivation with intensive agricultural methods and the sharp diminution or disappearance of fallow periods. The land-use categories are roughly parallel with increasing population densities. However, man-land relationships do not always hold at high densities because of labor shifts into non-agricultural sectors. The agricultural categories are also roughly concurrent with the land-use stages of (1) ecological balance, (2) soil exhaustion, (3) soil and water conservation. It is suggested that in land-use studies, diagnoses of population densities are le critical than identification of the transitional peri from rotational bush fallowing to permanent c tivation. (Casey-Arizona)
W70-10310

MAN-WATER RELATIONS IN THE EAST CE TRAL SUDAN,
Birbeck Coll., London (England). Dept. of Geo raphy.
For primary bibliographic entry see Field 06G.
W70-10311

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

LINEAR DECISION RULE IN RESERVOI MANAGEMENT AND DESIGN 2. PER FORMANCE OPTIMIZATION,
Cornell Univ., Ithaca, N.Y.; and Geological Survey Arlington, Va.
For primary bibliographic entry see Field 06A.
W70-10054

APPLICATION OF LINEAR RANDOM MODELS TO FOUR ANNUAL STREAMFLOW SERIES,
Alaska Univ., College; and Wisconsin Univ. Madison.
For primary bibliographic entry see Field 02A.
W70-10069

RADIOMETRIC METHOD OF SEEPAGE CON TROL IN DAMS AND THEIR ENVIRONS (RUSS SIAN),
Polish Academy of Science, Gdansk. Inst. o Hydraulic Research.
For primary bibliographic entry see Field 07B.
W70-10105

LOCALIZATION OF LEAKAGES FROM A LARGE RESERVOIR, USING RADIOACTIVE TRACERS (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
For primary bibliographic entry see Field 07B.
W70-10110

THE STORAGE COEFFICIENT AS A FUNC TION OF WATER TABLE CELERITY,
Washington State Univ., Pullman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W70-10119

STEINLE V CITY OF CINCINNATI (CITY'S LIABILITY FOR SUBSIDENCE DAMAGE CAUSED BY LEAKING SEWERS).
For primary bibliographic entry see Field 06E.
W70-10138

ULTRASONIC FLOWMETER,
Public Works Research Inst., Tokyo (Japan).
Takeo Kinosita.
Seventh Congress on Irrigation Drainage, Quest 24, Rep Disc, R1-R24, Mexicao City, p 24.307-24.318, 1969. 14 p, 11 fig, 2 tab.

Descriptors: *Flow measurement, *Flowmeters, *Ultrasonics, Field tests, Water management (Applied), Electronic equipment, Transducers, Velocity distribution, Laboratory tests, Foreign research, Velocity, Research and development, Measuring instruments, Instrumentation, *Discharge measurement, *Water measurement.

Identifiers: *Ultrasonic flow measurement, Test results, Japan, *Sing around system.

Flow measurement is an important procedure for water management, and is very important in irrigation and drainage. The ultrasound method of measuring flow is discussed. The 5 different kinds of ultrasonic systems available for flow measurement are: (1) beam deflection, (2) phase comparison, (3) pulse transit, (4) sing around, and (5) Doppler. Systems (1), (2), (3), and (5) need correction of the ultrasonic velocity that depends upon water temperature, density, and pressure. System (4) has no relation to the ultrasonic velocity, and is reviewed. The basic idea of the sing around system, the application to flow measurement, and use when velocity distribution is not uniform are examined. A preliminary experiment in flow measurement was performed in the laboratory prior to a field installation in a drainage channel. Results of the field installation indicated that measurement of mean velocity by ultrasound agreed well with a Price meter. (USBR)
W70-10139

BREAKING THE ICE BARRIER - A REPORT ON A DRAMATIC MISSION THAT LEARNED IT CAN BE DONE,
Saint Lawrence Seaway Development Corp.
George E. Wilson.
Seaway Review, Vol 1, No 1, p 19-22, 26, Spring 1970. 5 fig.

Descriptors: *Ice breakup, *Navigation, Economic feasibility, *St. Lawrence seaway.
Identifiers: Finncarrier, Michigan's Upper Peninsula, Baltic Sea.

The economic feasibility of and technological capacity for keeping the St. Lawrence Seaway navigable throughout the year are examined in this paper. At the present time the Seaway is impassable during several winter months because of ice conditions. Ice breaking operations on the Baltic Sea, which provide for year-round transportation of commerce, were observed by an investigative mission from the Seaway area. This article lists several reasons why similar ice breaking operations should be instituted for the Seaway. The costs of transportation on the Great Lakes would be reduced with year-round navigation; Michigan's iron mines are losing business to foreign competitors who have year-round access to the Eastern Seaboard; and Great Lakes ship builders are unable to bid for contracts which require delivery during winter. (Holmes-Rutgers)
W70-10179

RYDER V TOWN OF LEXINGTON (CITY'S LIABILITY FOR WATER DAMAGE CAUSED BY DRAINAGE WATER OVERLOAD OF STREAM).
For primary bibliographic entry see Field 06E.
W70-10214

ADAMS V TOWN OF RUSTON (ACCELERATED EROSION OF NATURAL STREAM BY DISCHARGE OF SWIMMING POOL WATER).
For primary bibliographic entry see Field 02E.
W70-10216

MEKONG DELTA MATHEMATICAL MODEL PROGRAM CONSTRUCTION,
Bologna Univ. (Italy); and Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
Dino Zanobetti, Henri Lorgere, Alexandre Preissmann, and Jean Andre Cunge.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW2, Paper 7259, p 181l-199, May 1970. 19 p, 8 fig, 4 tab, 8 ref, append.

Descriptors: *Deltas, *Flood control, *Reservoirs, *Mathematical models, *Computer programs, Systems analysis, Model studies, Computer models, Digital computers, Routing, Water levels, Stage-discharge relations, Dams.
Identifiers: *Cambodia, *Vietnam, *Mekong River, Tonle Sap.

Control of the flood which periodically inundates 50,000 sq km in the Lower Basin of the Mekong river in Cambodia and South Vietnam is proposed by means of a barrage across the Tonle Sap. This would transform the Great Lake of Cambodia into a 72 billion cu m reservoir. A model of the system consists of a system of ordinary first order differential equations each representing water level as a function of time in one of the some 300 meshes into which the area is divided. Exchange relations between cells are based on Saint Venant's dynamic equations or on the weir type exchange laws, inertia terms being ignored in both cases due to the very small velocity of flood propagation. Boundary conditions are represented by about 50 additional imaginary cells. A flood lasting 3.5 months corresponds to about 120 computation cycles with a time increment varying between 6 hr and 48 hr. It requires about 1 hr of computer time. Printout is done by means of the IBM 1401. (Knapp-USGS)
W70-10264

FLOOD PLAIN INFORMATION, EAST FORK SAN JACINTO RIVER, REESE AND TARKINGTON BAYOUS, CLEVELAND, TEXAS.
Corps of Engineers, Galveston, Tex.

US Army Corps of Engineers Flood Plain Report, June 1970. 41 p, 5 fig, 14 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *San Jacinto River (Tex), Cleveland (Tex), Standard project flood, Intermediate regional flood.

Flooding of the East Fork San Jacinto River, Cleveland, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-10275

FLOOD PLAIN INFORMATION, PASCAGOULA - GAUTIER COASTAL AREA, JACKSON COUNTY, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.

US Army Corps of Engineers Flood Plain Report, June 1970. 31 p, 7 fig, 15 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Mississippi, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Hurricanes, Rainfall, Storm runoff, Historic flood.
Identifiers: Jackson County (Miss).

Flooding of the Pascagoula-Gautier Coastal area, Jackson County, Mississippi is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-10276

BENSON V CITY OF ANDALUSIA (CONSTITUTIONALITY OF ORDINANCE FOR OPERATION OF CITY SEWAGE SYSTEM).
For primary bibliographic entry see Field 06E.
W70-10299

EMERY V ORLEANS LEVEE BD (DEDICATION OF STATE PROPERTY VIA ACT AUTHORIZING PROJECT CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W70-10359

DOES BEDDING PROMOTE PINE SURVIVAL AND GROWTH ON DITCHED WET SANDS.
Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station.
For primary bibliographic entry see Field 02I.
W70-10409

FILTROL CORP V HUGHES (REASONABLE USE OF LAND AFFECTING SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
W70-10420

MILLER V UNITED STATES (EVALUATION OF LAND CONDEMNED BY UNITED STATES).

137 F2d 592-596 (3rd Cir 1943).

Descriptors: *Pennsylvania, *Compensation, *Condemnation value, *Condemnation, Eminent domain, Federal government, Judicial decisions, Legal aspects, Riparian land, Value, Market value, Property values, Appraisals, Evaluation, Damages, Damsites, Dams, Reservoir storage, Flood control, Impounded waters, Impoundments, Drainage, Mine drainage.

Plaintiff brought action to recover severance damages for land taken under condemnation proceedings by the United States. The land had been condemned for the purpose of constructing a dam and reservoir in conjunction with a flood control project. Plaintiff contended that the water impounded by the dam would create a mental hazard which would decrease the value of his remaining property. Defendant contended that the danger of floods below the dam would be greatly decreased by the project. Plaintiff made no attempt to prove the dam was improperly constructed, that water would overflow barriers constructed by defendant or that the dam would add to the normal drainage problems present in the area. Furthermore, only a small amount of water was impounded behind defendant's dam. Therefore, the testimony as to the alleged mental hazard created by the dam and impounded waters was properly excluded below. The judgment for defendant was affirmed. (Price-Florida)
W70-10428

UNITED STATES V CHICAGO BURLINGTON AND QUINCY RR (RECOVERY OF DAMAGES PROXIMATELY CAUSED BY DAM CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W70-10430

CAMDEN SEWER CO V MAYOR AND COUNCIL (USE OF SEWERS IN SURFACE WATER DRAINAGE).
For primary bibliographic entry see Field 06E.
W70-10446

ALOTTO V CITY OF CORNING (CAUSE OF ACTION FOR CONTINUING WATER DAMAGE).
For primary bibliographic entry see Field 06E.
W70-10450

MORETTI V VILLAGE OF PEEKSKILL (DIVERSION OF STREAMFLOW).
For primary bibliographic entry see Field 06E.
W70-10451

ELDRED DRAINAGE AND LEVEE DIST V WILCOXSON (DRAINAGE DISTRICT'S AUTHORITY TO LEVY AN ASSESSMENT TO PAY A JUDGMENT FOR DAMAGES).
For primary bibliographic entry see Field 06E.
W70-10456

HEID V ALLEGHENY COUNTY (DAMAGES FROM DIVERSION OF SURFACE WATER FLOW BY HIGHWAY IMPROVEMENTS).
For primary bibliographic entry see Field 06E.
W70-10465

LUCAS V CITY OF LOUISIANA (FLOOD DAMAGE CAUSED BY CITY'S NEGLIGENT FAILURE TO REMOVE OBSTRUCTION IN STREAM).
For primary bibliographic entry see Field 06E.
W70-10469

CITY OF LOUISVILLE V COPE (LIABILITY FOR FLOOD DAMAGE CAUSED BY WATER BACKING UP FROM CITY'S STORM DRAIN).
For primary bibliographic entry see Field 06E.
W70-10470

TESENEER V HENRIETTA MILLS CO (RIGHT TO RECOVER PERMANENT DAMAGES FOR NEGLIGENT OPERATION DAM).
For primary bibliographic entry see Field 06E.
W70-10473

SOUTHLAND COFFEE CO V CITY OF MACON (LIABILITY FOR DAMAGES RESULTING FROM EXTRAORDINARY RAINFALL).
For primary bibliographic entry see Field 06E.
W70-10476

JOHNSTON V CITY OF ATLANTA (MUNICIPALITY NOT LIABLE FOR ERROR OF JUDGMENT IN SEWER SYSTEM PLANNING).
For primary bibliographic entry see Field 06E.
W70-10477

HASER V ALLEGHENY COUNTY (CONDEMNATION PROCEEDING TO CHANGE LOCATION OF A CREEK BED).
For primary bibliographic entry see Field 06E.
W70-10478

NICHOLS V CITY OF MORRISTOWN (LIABILITY FOR INJURY DUE TO INADEQUACY OF CREEK TO ACCOMMODATE SURFACE WATER).
For primary bibliographic entry see Field 02E.
W70-10483

CIMINELLI V LIBURDI (FLOOD DAMAGE RESULTING FROM GRADE CHANGE BY ADJOINING LANDOWNERS).
For primary bibliographic entry see Field 06E.
W70-10485

CULLEY V HOLLIS (RIGHTS OF OWNERS OF LAND ABUTTING NAVIGABLE STREAMS TO ERECT IMPROVEMENTS IN SUCH STREAMS).
For primary bibliographic entry see Field 06E.
W70-10495

LEARY V CITY OF MANCHESTER (LIABILITY FOR NUISANCE CREATED BY FAILURE TO PROPERLY MAINTAIN DRAINAGE DITCH).
For primary bibliographic entry see Field 06E.
W70-10499

ROONEY V MILLSTONE TP (DAMAGES FROM DISCHARGE OF SURFACE WATER DRAINAGE).
For primary bibliographic entry see Field 06E.
W70-10500

4B. Groundwater Management

MODEL STUDIES OF TIDAL EFFECTS ON GROUNDWATER HYDRAULICS,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-10034

GROUNDWATER LEVELS IN NEBRASKA,
Geological Survey, Lincoln, Nebr.
C. F. Keech.
Nebraska Water Survey Paper 26, May 1970. 83 p, 8 fig, 1 tab.

Descriptors: *Water levels, *Groundwater, *Hydrologic data, *Nebraska, Data collection, Monitoring, Observation wells, Water wells, Water level fluctuations, Irrigation water, Water utilization, Evapotranspiration.
Identifiers: Groundwater data.

This report contains measurements made in selected wells, in Nebraska strategically located to indicate net water-level changes. All the important aquifers are represented by at least one observation well. Except for a few measurements and the 50 recording gages that continually monitor water-level fluctuations in the well, water levels are obtained in the fall, several weeks after the close of the irrigation season. Of the 33,791 registered irrigation wells, 1,361 were registered during 1969 with the Nebraska Department of Water Resources. Only 35 of the 93 counties in the State ended the 1969 year with average water levels in wells lower than the fall of 1968. Most western counties were drier than normal. (Knapp-USGS)
W70-10071

HOW MUCH UNDERGROUND WATER STORAGE CAPACITY DOES TEXAS HAVE,
Texas Water Development Board, Austin. Groundwater Div.
Gunnar Brune.
Water Resources Bulletin, Vol 6, No 4, p 588-601, July-August, 1970. 14 p, 7 fig, 2 tab, 20 ref.

Descriptors: *Water storage, *Aquifers, *Texas, *Inter-basin transfers, Water conveyance, Water resources development, Water transfer, Planning, Water levels, Drawdown, Evapotranspiration, Artificial recharge, Injection wells, Conjunctive use.
Identifiers: Texas Water Plan.

Water imported into Texas under the Texas Water Plan must be stored in surface or underground reservoirs. Groundwater levels are being drawn down heavily in many parts of Texas. This is causing a shift of much water from a surface water to a groundwater environment. The lowering water tables have resulted in a great reduction in wastage of water through evapotranspiration and spring and well flow. The methods used in estimating the quantities of underground storage capacity available in Texas are discussed. Some problems will be encountered in the use of dewatered underground storage capacity by artificial recharge. In spite of these problems, probably 60 to 70% of the dewatered storage capacity of Texas aquifers can be reused for groundwater storage. Most of this capacity is located where it can be used in conjunction with the Texas Water Plan. (Knapp-USGS)
W70-10081

OXYGEN-18 AND TRITIUM IN THE EVIAN BASIN (FRENCH),
Geodynamics Investigation Center, Paris (France).
For primary bibliographic entry see Field 02K.
W70-10095

SOUTHERN MARYLAND RECORDS C
SELECTED WELLS, WATER LEVELS, AN
CHEMICAL ANALYSES OF WATER,
Geological Survey, Towson, Md.
James M. Weigle, and Wayne E. Webb.
Maryland Geological Survey Basic Data Report N
4, 1970. 48 p, 1 fig, 4 plate, 5 tab, 5 ref.

Descriptors: *Water wells, *Data collection
*Water levels, *Groundwater, *Maryland, Survey
Investigations, Hydrologic data, Geolog
Hydrogeology, Water quality, Water suppl
Aquifers, Observation wells.
Identifiers: Calvert County (Md), Charles Count
(Md), St. Marys County (Md).

This report presents basic data collected as part
a study of water resources in southern Maryland
the U. S. Geological Survey in cooperation with th
Maryland Geological Survey. Included in the are
investigated are Calvert, Charles, and St. Mary
Counties--1044 square miles of land area limite
on the east by Chesapeake Bay and on th
southwest by the Potomac River. The data in th
report include records of about 424 wells and tes
holes, chemical analyses of water from 150 well
and 13 stream sites, and hydrographs based o
periodic measurements of water levels in 17 wells
Drillers' logs are available for many wells
Geophysical logs (gamma and/or electric) ar
available for some wells. Hydrographs show wate
level changes in observation wells in Calver
Charles, and St. Marys Counties and southernmos
Prince Georges County for their periods of record
The corresponding water-level measurements fo
those periods are available, and the wells at whic
the measurements were made are described. (K
napp-USGS)
W70-10231

HYDROGEOLOGIC DATA FOR THE LOWE
HOUSATONIC RIVER BASIN, CONNECTICUT,
Geological Survey, Hartford, Conn.
I. G. Grossman, and William E. Wilson.
Connecticut Water Resources Bulletin No 20
1970. 50 p, 2 fig, 1 plate, 5 tab, 14 ref.

Descriptors: *Hydrologic data, *Water wells
*Streamflow, *Connecticut, *Data collection
Hydrogeology, Water levels, Aquifers, Water quali
ty, Geology, Publications.
Identifiers: Housatonic River basin (Conn).

Hydrologic and geologic data collected for an in
vestigation of the lower Housatonic River basin by
the U. S. Geological Survey are presented. The
basic-data report can be used for detailed informa
tion needed in planning water resources develop
ment at specific sites. The locations of sites a
which data were collected are shown on plate A.
Tables include records of 261 wells and logs of 8
wells and 456 test holes. Partial records of stream
flow discharge measurements collected at gaging
stations within the report area in the period 1965 t
1967 were augmented by stage measurements. (K
napp-USGS)
W70-10233

HYDROLOGIC CONDITIONS AND ARTIFI
CIAL RECHARGE THROUGH A WELL IN THE
SALEM HEIGHTS AREA OF SALEM,
OREGON,
Geological Survey, Tacoma, Wash.
Bruce L. Foxworthy.
For sale by the Superintendent of Documents, US
Government Printing Office, Washington, DC
20402. US Geological Survey Water-Supply Paper
1594-F, 1970. 56 p, 6 fig, 2 plate, 5 tab, 27 ref.

Descriptors: *Artificial recharge, *Injection wells,
*Oregon, Water levels, Basalts, Aquifers, Water
yield, Water quality, Permeability, Transmissivity,
Suspended load.
Identifiers: Salem (Oregon).

In the Salem Heights area of Salem, Oreg., pumping from wells that tap a permeable zone of limited extent in basalt of the Columbia River Group caused serious year-to-year declines of groundwater levels. To determine the feasibility of reducing these declines by artificially augmenting the natural recharge and to develop techniques applicable to a municipal program of artificial recharge, 24.5 million gallons of surplus water was injected under pressure into one of the municipal wells during three periods, ranging in duration from 1 to 15 days, at an average injection rate of about 830 gallons per minute. The recharge water contained abundant dissolved air and, at times, excessive sediment; in other respects it was of excellent quality and was compatible with the native groundwater. The artificial recharge had no apparent deleterious effects on the quality of the groundwater. Pressure rise from the injected water spread rapidly through the permeable aquifer, but the residual buildup of groundwater levels was soon masked by a seasonal rising trend of levels. The geologic and hydrologic conditions, however, preclude the escape of substantial volumes of the recharge water. The conditions appear to be favorable for further artificial recharge. Changes in the specific capacity of the recharge well provide valuable guidance for subsurface injection operations. (Knapp-USGS)
W70-10236

WATER RESOURCES AT MARINE CORPS SUPPLY CENTER, BARSTOW, CALIFORNIA FOR THE 1969 FISCAL YEAR,
Geological Survey, Menlo Park, Calif.
J. H. Koehler.
US Geological Survey Open-file report, May 18, 1970. 22 p, 5 fig, 4 tab, 4 ref.

Descriptors: *Water supply, *Water resources development, *California, Aquifers, Water wells, Groundwater, Hydrogeology, Sampling, Data collections, Hydrologic data.
Identifiers: Barstow (Calif), Aquifer testing, Pumping tests.

The water supply for the Marine Corps Supply Center, Barstow, California is obtained from wells in the Barstow and Yermo groundwater subunits of the Mojave River basin. Recharge to the groundwater subunits depends almost entirely on seepage from floodflow in the Mojave River. In the 1969 water year the total flow at the gage at Barstow was 146,000 acre-feet which resulted in about 60,000 acre-feet of recharge to the groundwater subunits. Between March 1968 and April 1969 the water levels rose an average of 1.2 feet in the Yermo supply wells and 10.1 feet in the Nebo supply wells. The chemical quality of water from the Yermo supply wells is within the U.S. Public Health Service recommended limits for dissolved chemical constituents. Pumping tests were made of nine supply wells in the summer of 1969. The pumping test of well 9N/1E-3P2 (Yermo 5), drilled in July 1969, indicates that this well could be pumped at a sustained yield of at least 2,500 gpm. (Knapp-USGS)
W70-10237

GROUNDWATER GEOLOGY OF THE ROCK ISLAND, MONMOUTH, GALESBURG, AND KEWANEE AREA, ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 02F.
W70-10284

4C. Effects on Water of Man's Non-Water Activities

WATER IN URBAN PLANNING, SALT CREEK BASIN, ILLINOIS--WATER MANAGEMENT AS RELATED TO ALTERNATIVE LAND-USE PRACTICES,
Geological Survey, Washington, D.C.
Andrew M. Spieker.

For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $1.00. U S Geological Survey Water-Supply Paper 2002, 1970. 147 p, 52 fig, 5 tab, 33 ref.

Descriptors: *Water pollution, *Urbanization, *Illinois, Surface waters, Groundwater, Aquifers, Groundwater recharge, Streamflow, Drainage, Topography, Soils, Floods, Water quality, Water management (Applied), Water pollution control.
Identifiers: *Changing land use, Flood control measures.

This report concentrates on related urbanization problems of groundwater recharge, water quality, management of flood plains, and flood-control measures in the Salt Creek basin in Cook and Du Page Counties of the rapidly developing Chicago metropolitan area. Salt Creek basin has a drainage area of 150 square miles. It is in flat to gently rolling terrain, underlain by glacial drift as much as 200 feet thick which covers a dolomite aquifer. In 1964, the population of the basin was about 400,000, and 40% of the land was in urban development. The population is expected to number 550,000 to 650,000 by 1990, and most of the land will be taken by urban development. (Woodard-USGS)
W70-10070

JOHNSON V SOWELL (DAMAGE MEASURE WHERE SAND AND GRAVEL BASIN OVERFLOWS ONTO ADJOINING FARMLAND).
For primary bibliographic entry see Field 06E.
W70-10115

HAMRICK V CITY OF ALBERTVILLE (CITY'S LIABILITY FOR FLOODING CAUSED BY ROAD IMPROVEMENT).
For primary bibliographic entry see Field 06E.
W70-10217

EFFECTS OF CLEAR-CUTTING ON STREAM TEMPERATURE,
Oregon State Univ., Corvallis.
George W. Brown, and James T. Krygier.
Water Resources Research, Vol 6, No 4, p 1133-1139, August 1970. 7 p, 4 fig, 1 tab, 13 ref. FWPCA Grant WP-423.

Descriptors: *Water temperature, *Clear-cutting, *Thermal pollution, *Water pollution sources, *Lumbering, Forest management, Forestry, Solar radiation, Oregon, Vegetation effects.
Identifiers: Clear-cutting effects (Water temperature).

The amount of sunlight effective in warming streams may be increased after clear-cut logging. Average monthly maximum temperatures increased by 14 deg F and annual maximum temperatures increased from 57 deg to 85 deg F one year after clear-cut logging on a small watershed in Oregon's coast range. In a nearby watershed where strips of brush and trees separated logging units from the stream, no changes in temperature were observed that could be attributed to clearcutting. (Knapp-USGS)
W70-10248

STREAMFLOW CHANGES AFTER FOREST CLEARING IN NEW ENGLAND,
Forest Service (USDA), Durham, N. H. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 03B.
W70-10249

CITY OF BIRMINGHAM V NICHOLS (ACCELERATED EROSION OF RAVINE EXCAVATED BY CITY).
For primary bibliographic entry see Field 02E.
W70-10288

ALEXANDER V CITY OF SHREVEPORT (EROSION OF PROPERTY BY WATER FLOWING FROM CITY CULVERT).
For primary bibliographic entry see Field 06E.
W70-10358

SOME PRINCIPLES OF FOREST HYDROLOGY PERTINENT TO EVEN-AGED MANAGEMENT OF EASTERN HARDWOODS,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
J. H. Patric.
Northern Logger and Timber Processer, July 1970, p 14-15, 26-27.

Descriptors: *Mountain forests, *Rainfall-runoff relationships, *Small watersheds, Accelerated erosion, Demonstration watersheds, Overland flow, Soil erosion, Soil stability, West Virginia.
Identifiers: *Clearcutting, *Logging roads, Forest watersheds, Logging, Turbidity, Experimental watersheds.

There is an historical basis for public and professional concern that the present swing to even-aged management of eastern hardwoods will have unwanted effects on forest water resources. Nevertheless, a review of the relevant literature shows that (1) clearcutting per se has negligible effect on hydrologic properties of forest soils, (2) clearcutting increases streamflow, and (3) logging roads cause most of the damage to streams draining clearcut forest land. (Patric-Forest Service)
W70-10421

4D. Watershed Protection

EROSION, RUNOFF, AND REVEGETATION OF DENUDED CONSTRUCTION SITES,
Agricultural Research Service, Lafayette, Ind. Soil and Water Conservation Research Div.; and Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
L. D. Meyer, W. H. Wischmeier, and W. H. Daniel.
Paper No 69-704, presented at American Society of Agricultural Engineers 1969 Winter Meeting, Chicago, Illinois, Dec 9-12, 1969. 8 p, 4 fig, 2 tab, 24 ref.

Descriptors: *Erosion, *Land forming, *Urbanization, *Sediment yield, *Sediment control, Road construction, Sedimentation rates, Slope stability, Soil conservation, Revegetation, Simulated rainfall, Erosion control, Land development.
Identifiers: Construction site erosion.

Erosion and runoff rates were measured for six treatments representing typical construction site conditions that result from major land reshaping. Subsequently, reestablishment of vegetation on these conditions was studied in relation to various methods of reshaping, mulching, fertilizing, and seeding. A series of simulated rainstorms totaling 5 inches was applied at an intensity of 2.5 in/hr on 35-foot subsoil plots with 12 percent slopes. The resulting erosion and runoff were very great. The only treatment that effectively controlled erosion was straw mulch, which reduced soil loss to less than 10 tons per acre. Of of the five original treatments on which revegetation was studied, applied topsoil was by far the most successful treatment. Mulched subplots were greatly superior to unmulched. A layer of good soil over a denuded area plus surface mulch is the best combination of those treatments tested for minimizing soil erosion and enhancing rapid revegetation on reshaped land. Additional benefits may be expected from minimized compaction of such areas, shallow surface tillage before seeding, use of a seed mixture containing fast-growing grasses, and application of supplemental irrigation as needed. (Knapp-USGS)
W70-10280

WATER RESOURCES PROBLEMS: PRESENT AND FUTURE REQUIREMENTS FOR LIFE,
For primary bibliographic entry see Field 06D.
W70-10312

LAND CAPABILITY: A HYDROLOGIC RESPONSE UNIT IN AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02E.
W70-10407

WATER REGULATION ON FOREST LAND.
Forest Service (USDA), Charleston. Southeastern Forest Experiment Station.
For primary bibliographic entry see Field 02I.
W70-10408

FOLKLORE AND BROMIDES IN WATERSHED MANAGEMENT.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
Richard S. Sartz.
Journal of Forestry Vol 67, No 6, p 366-371, June 1969.

Descriptors: *Watershed management, *Springs, *Snow management, *Erosion, Burning, Clear-cutting, Forest management, Distribution, Porosity, Interception.

Some common folklore and 'bromides' regarding the influence of forests and the effect of management practices on streamflow are examined in terms of fundamental concepts and research results. The topics discussed are: The interception paradox; organic layers--is twice as much twice as good. That ever-elusive field capacity; and logging, burning, grazing--good bad or indifferent.
W70-10410

A REVIEW OF 'HANDBOOK OF AFFORESTATION AND SOIL MELIORATION', A. V. AL'-BENSKII AND P. D. NIKITIN, EDITORS,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
James H. Patric.
Journal of Soil and Water Conservation, Vol 24, No 6, Nov-Dec 1969, p 238.

Descriptors: *Forestry, *Forests, *Shelterbelts, *Soil conservation, *Soil management, Drainage, Evapotranspiration, Land reclamation, Rainfall disposition, Snowmelt, Soil freezing.
Identifiers: Agro-silviculture.

Although Russian agrosilvicultural practices often resemble those used in this country, they developed under social and economic conditions so different from ours that the book provides little more than academic interest to most American conservationists. (Patric-Forest Service)
W70-10416

LOGGING ROADS AND WATER QUALITY,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
James H. Patric.
Proc Forest Engineering Workshop on Forest Roads, W. Va. University, 1970, p 11-16.

Descriptors: *Impaired water quality, *Soil contamination, Fertilizers, Gasoline, Oil wastes, Turbidity, Water pollution sources, Water temperature, West Virginia, Soil erosion.
Identifiers: *Forest roads, Logging roads.

Soil from eroding logging roads is the mot common and harmful pollutant of forest streams in West Virginia. Some consequences of pollution by soil and other contaminants from logging roads are reviewed. Forest managers can avoid most of this damage to water quality by applying known methods of water control on logging roads. (Patric-Forest Service)
W70-10417

EROSION CONTROL ON LOGGING ROADS IN THE APPALACHIANS,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
James N. Kochenderfer.
USDA Forest Serv Res Paper NE-158, NE, Forest Exp Sta, Upper Darby, Pa., 28 p, illus, 1970.

Descriptors: *Erosion, *Maintenance, *Roads, *Soil stabilization, Bank stabilization, Soil conservation, Soil erosion, Soil stability, Appalachian Mountain Region, West Virginia.
Identifiers: *Logging roads, Erosion control structures, Forest roads, Road location, Traffic control, Vegetation.

Practical methods of controlling erosion on logging roads are summarized through the different stages--planning, location, drainage, maintenance, and care after logging. The material was derived from existing literature, road lore, contact with experienced land managers, and personal experience. (Kochenderfer-Forest Service)
W70-10418

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

IDENTIFICATION OF OIL SPILLS: COMPARISON OF SEVERAL METHODS,
Melpar, Inc., Falls Church, Va.
J. Horowitz, G. D. Gumtz, R. G. Nemchin, and T. P. Meloy.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 283-296, 1970. 14 p, 88 ref.

Descriptors: *Tagging, *Tracking techniques, *Oily water, *Water pollution control, *Tracers, Analytical techniques, Water chemistry, Pollutant identification, Marking techniques, Legal aspects.
Identifiers: Oil spill treatment.

Several methods of identifying the source of oil pollution are critically examined. These methods are grouped into passive tagging and active tagging. Passive tagging assumes that oils are so chemically diverse that their contents constitute a stable chemical fingerprint that can be unequivocally disclosed in the laboratory. Active tagging requires that an inexpensive, coded material be added to oil; this material must be chemically and plysically stable in both oil and oil slicks; it must also be readily identifiable by available analytical techniques. Trace metals, sulfur-isotope ratios, paper chromatography, halogenated polycyclic aromatics, organometallics, and coded microspheroids were studied. Passive tags are not recommended because the passive tags are quite likely to mingle, to evaporate, to be dissolved, or to be oxidized. Even if these processes do not occur, they can create formidable forensic problems. Active tags are stable and identifiable. (See also W70-10035). (Knapp-USGS)
W70-10044

REMOTE SENSING OF OIL SLICKS,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Water Quality Research.
L. G. Swaby, and A. F. Forziati.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 297-307, 1970. 11 p, 14 fig, 10 ref.

Descriptors: *Remote sensing, *Oily water, *Pollutant identification, Aerial photography, Water pollution control, Water pollution treatment, Satellite (Artificial), Aircraft, Infrared radiation.
Identifiers: Oil spills, Oil-slick sensing.

An overview of remote sensing methods presented and illustrated with data taken at the Santa Barbara oil spill. Such methods possess monitoring capability but so far the ability to identify the slick material as oil has not been demonstrated. The advantages and disadvantages of each method are briefly discussed. (See also W70-10035). (Knapp-USGS)
W70-10045

PESTICIDES IN SURFACE WATERS OF THE UNITED STATES--A 5-YEAR SUMMARY, 1964-68,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Analytical Quality Control Branch.
James J. Lichtenberg, James W. Eichelberger, Ronald C. Dressman, and James E. Longbottom.
Pesticides Monitoring Journal, Vol 4, No 2, p 71-86, September 1970. 16 p, 2 fig, 8 tab, 9 ref.

Descriptors: *Pesticides, *Water quality, *Water pollution sources, *Chlorinated hydrocarbon pesticides, Surveys, Reviews, Data collections, Analytical techniques, Persistence.
Identifiers: Pesticides in water.

This report summarizes the results of five annual synoptic surveys (1964-68) for chlorinated hydrocarbon pesticides in surface waters of the United States. The results showed widespread occurrence of these compounds. The number of occurrences reached a peak in 1966 and then declined sharply in 1967 and 1968. Dieldrin and DDT and its congeners DDE and DDD were the compounds most frequently detected throughout the 5-year period. The maximum concentrations found have not exceeded permissible limits as they relate to human intake directly from a domestic water supply. However, they have often exceeded the environmental limit of 0.050 micrograms/liter recommended by the Federal Committee on Water Quality Criteria. (Knapp-USGS)
W70-10050

NATURAL TRITIUM IN GROUNDWATER STUDIES,
Iceland Univ., Reykjavik.
For primary bibliographic entry see Field 02F.
W70-10093

TRITIUM HYDROLOGY IN NEW ZEALAND,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Div. of Nuclear Sciences.
For primary bibliographic entry see Field 02F.
W70-10094

OXYGEN-18 AND TRITIUM IN THE EVIAN BASIN (FRENCH),
Geodynamics Investigation Center, Paris (France).
For primary bibliographic entry see Field 02K.
W70-10095

EVOLUTION OF TRITIUM ACTIVITY IN THE SOUTH-WEST OF FRANCE (FRENCH),
Institute of Geology of the Aquitaine Basin, Bordeaux (France). Faculty of Sciences.
For primary bibliographic entry see Field 02H.
W70-10096

TRITIUM AND HYDROGEOLOGY-INVESTIGATIONS AND MEASUREMENTS CARRIED OUT AT THE GRENOBLE NUCLEAR RESEARCH CENTER (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
For primary bibliographic entry see Field 07A.
W70-10097

SEASONAL VARIATIONS IN THE TRITIUM CONTENT OF GROUNDWATERS OF THE VIENNA BASIN, AUSTRIA,
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 02F.
W70-10098

ACTIVABLE RARE EARTH ELEMENTS ESTUARINE WATER TRACERS,
Stanford Univ., Calif. Dept. of Civil Engineering; and Public Health Service San Francisco, Calif.
J. K. Channell, and P. Kruger.
Fifth International Water Pollution Research Conference, San Francisco, July 26-Aug 1, 1970. Preprint, 20 p, 5 fig, 4 tab.

Descriptors: *Tracers, Estuary, Bottom sediments, Solubility, Chelation, Absorption, Sewage, Turbidity, Costs, Hydrogen ion concentration, Estuaries, Analytical techniques.
Identifiers: Nuclear Activation Analysis, San Francisco Bay, *Rare earth elements, *Europium, *Lanthanum.

A reliable analytical method has been developed for separating the rare-earth elements (REE) as a group from estuarine water and detecting europium and lanthanum in quantities as low as 1 ng and 20 ng per sample. Although REE may adsorp to suspended solids at normal pH, the analytical method measures these together with those in solution. Losses to bottom sediments can be estimated and are not serious for estuaries with average depths greater than 10 ft. These characteristics enable REE to be used in tracing the dissolved, suspended solids, and settleable solids phases of sewage effluent. Estuarine water can also be traced if REE are injected at a low pH in areas of low suspended solids concentration. The activable REE can also be used as multiple tracers or to extend the range of fluorescent dye or radionuclide tracers. The minimum detectable amount of added tracer is 110 ng/l for lanthanum and 15 ng/l for europium. Lanthanum tracer is less expensive than Rhodamine WT dye in large studies. Estimated lanthanum costs are slightly greater than tritium of La140 for large studies but may be preferable because of radiological health considerations. Europium is not economically competitive. (Upadhyaya-Vanderbilt)
W70-10210

THE QUALITY OF ARIZONA'S DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATERS,
Arizona Univ., Tucson. Agricultural Experiment Station.
G. R. Dutt, and T. W. McCreary.
Available from NTIS as PB-194 530, $3.00 in paper copy, $0.65 in microfiche. Arizona University Agricultural Experiment Station Report 256, February 1970. 83 p, 12 fig, 12 tab, 77 ref. OWRR Projects B-001-ARIZ (3), B-002-ARIZ (4), B-004-ARIZ (2).

Descriptors: *Water quality, *Arizona, Water chemistry, Surface waters, Groundwater, Sampling, Data collections, Hydrologic data, Trace elements, Water utilization.
Identifiers: Water quality data.

Waters of Arizona were sampled since 1966 to determine on a broad scope, not only the water quality with respect to the major ions but also the quality with respect to the minor or trace ions that may be either harmful or beneficial to the current and future uses. The concentration of the various solutes (dissolved substances) are compared to criteria to the effect of various solutes on the usefulness of water. (Knapp-USGS)
W70-10224

QUANTITY AND CHEMICAL QUALITY OF LOW FLOW IN THE PRAIRIE DOG TOWN FORK RED RIVER NEAR WAYSIDE, TEXAS, FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-10229

RAPID MEASUREMENT OF ORGANIC POLLUTION BY TOTAL ORGANIC CARBON AND COMPARISONS WITH OTHER TECHNIQUES,
Geological Survey, Menlo Park, Calif.
J. W. Helms.
U S Geological Survey Open-file report, May 21, 1970. 9 p, 3 fig, 33 ref.

Descriptors: *Water analysis, *Organic matter, Biochemical oxygen demand, Oxygen demand, Organic wastes, Pollutant identification, Organic loading, Analytical techniques, Chemical analysis.
Identifiers: Total organic carbon analysis.

Among the techniques for measuring carbonaceous material in water, the TOC (total organic carbon) determination is probably one of the best in terms of speed and accuracy. As a means of monitoring waste discharge, the TOC method is the most applicable. Results can be obtained promptly to allow corrective measures to be made before significant impairment occurs in the receiving water. Waste discharging facilities can utilize on-site TOC monitors to shorten the time interval when improper treatment processes allow objectionable waste to be discharged. TOC monitors may also prove useful in the monitoring of various stages of waste treatment. Modifications of treatments could be initiated almost immediately to cope with changes in waste composition. Plant wastes for a particular process or product are generally uniform in content. If a correlation is established between methods, that correlation should hold until the process is changed. Where wastes contain a myriad of organic compounds, if one or a few should change in concentration, good correlation should still be possible since the total composition remains fairly uniform. Municipal or sanitary wastes fall into this category. (Knapp-USGS)
W70-10261

AN AUTOMATED METHOD FOR DETERMINING MERCURY IN WATER,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
P. D. Goulden, and B. K. Afghan.
Canada Department Energy, Mines and Resources, Inland Waters Branch Technical Bulletin No 27, 1970. 21 p, 13 fig, 3 tab, 5 ref.

Descriptors: *Pollutant identification, *Water analysis, *Heavy metals, *Spectrophotometry, *Flame photometry, Trace elements, Laboratory tests, Analytical techniques, Poisons, Sampling, Automation, Instrumentation, Measurement.
Identifiers: Mercury, Mercury analysis, Atomic absorption spectrophotometry.

A method is given for determining the mercury content in water with mercury concentrations as low as 0.05 micrograms/liter. The method was applied to water samples containing both inorganic- and organo-mercury compounds. It involves the oxidation of organo-mercury compounds by ultraviolet irradiation followed by the reduction of the mercury to the elemental state. The mercury is swept out of the solution by a stream of air and its concentration measured in an absorption cell in an atomic absorption spectrophotometer. For levels of mercury in the range 1.0 to 32 micrograms/liter the method is automated to measure 20 samples per hour. For levels of mercury in the range 0.05 to 1.0 micrograms/liter only 10 samples per hour can be processed because a longer sampling time is required. (Knapp-USGS)
W70-10263

BIOLOGICAL SYSTEMS AS POLLUTION MONITORS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
John Cairns, Jr., Richard E. Sparks, and William T. Waller.
Research/Development, Vol 21, No 9, p 22-24, Sept 1970. 3 p, 6 fig.

Descriptors: *Monitoring, *Water pollution control, *Water pollution effects, *Bioindicators, Fish, Water chemistry, Toxicity, Trace elements, Poisons, Waste disposal.
Identifiers: Water pollution monitoring.

The use of continuous monitoring of the activity of aquatic life in a stream to detect an increase in the level of pollutants before the increase reaches the danger levels was studied using fish in tanks. Three biological parameters of fish--movement, breathing and electrocardial activity--are monitored with two types of apparatus. Basically, each apparatus consists of test chambers in which fish are maintained, sensing devices, amplifiers and records. The swimming movement monitor uses photoresistors as sensors. One fish is maintained in each of six, 5-gallon aquaria. Each aquarium is traversed by light beams at the top, middle and bottom levels. When a fish moves through a light beam at a particular level, a photoresistor acts through an amplifier to make a blip on an event recorder and to advance a digital counter. The breathing and electrocardial monitor uses a needle electrode inserted in the breast of the fish as a sensor. By using biological monitoring systems, it is possible to obtain quick information as to when a waste toxicant level changes. The type of information generated is of such a nature that it can be fed directly into a computer, and the time lag in determining changes can be significantly reduced. (Knapp-USGS)
W70-10273

SPECTRAL ANALYSIS--APPLICATIONS IN WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D.C. Estuarine and Oceanographic Programs Branch.
T. A. Wastler.
Federal Water Pollution Control Administration Report CWT, December 1969. 99 p, 34 fig, 13 tab, 17 ref.

Descriptors: *Statistical methods, *Frequency analysis, *Fourier analysis, *Time series analysis, *Water quality, Estuaries, Digital computers, Water pollution control, Analytical techniques, Data processing, Path of pollutants.
Identifiers: Spectral analysis.

The application of spectral analysis is explained for the interpretation of time series water quality data, both in estuaries and in free-flowing streams. The statistical manipulation of time-series data by spectral analysis results in the computation of those parts of the variance of a record that recur at constant time intervals as well as the part that is random (non-recurring) in character. The power spectrum computation is the fundamental operation of data reduction and interpretation by means of spectral analysis; the many other computations that can be made in spectral analysis are all based firmly upon the concept and calculation of individual power spectra. Like any other method of data analysis, this method has its limitations and disadvantages. Three major requirements for the record may be regarded as limiting. First, the record must be fairly long--generally having over 100 sequential measurements. Second, there must be no missing data--if measurements are missing, suitable values must be interpolated before spectral analysis is attempted. Third, the mathematical procedures require so much computation that the use of a high-speed digital computer is essential for most analyses. (Knapp-USGS)
W70-10279

ELECTROPHORETIC CLARIFICATION OF WATER,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 05D.
W70-10314

FISH BIOASSAYS - REPRODUCIBILITY AND RATING,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.

John Cairns, Jr.
Separata de Rivista de Biologia, Vol 7, Nos 1-2, p 7-12, 1969. 8 ref, 2 tab, 9 fig.

Descriptors: *Bioassay, *Methodology, *Test procedures, Laboratory tests, Testing, Variability, Laboratory animals, Acclimatization, Fish behavior.
Identifiers: *Reproducibility, *Rating system, Synthetic water, Test organisms, Fish bioassays.

This paper proposed that research bioassay investigations be carried out with methods and procedures that can be duplicated in other laboratories. Also suggested was a rating system to indicate how closely an author has adhered to generally accepted bioassay methodology. The two major obstacles to obtaining data that may be readily reproduced are lack of certainty regarding (1) the quality of the dilution water and (2) the uniformity of the response of the test organism. The use of synthetic dilution waters will overcome the first problem and using an accepted test species (list given) will overcome the second problem. (Sjolseth-Washington)
W70-10326

ASSAYING ALGAL GROWTH WITH RESPECT TO NITRATE CONCENTRATION BY A CONTINUOUS FLOW TURBIDOSTAT,
California Univ., Berkeley; and Ministry of Health, Jerusalem (Israel).
G. Shelef, W. J. Oswald, and C. C. Golueke.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint. 9 p.

Descriptors: *Analytical techniques, *Algae, *Assay, Chlorella, Nitrates, Chemical analysis, Chlorophyta, Diatoms, Temperature, Optical properties, Growth rates.
Identifiers: *San Joaquin Delta (Calif), *Continuous flow turbidostat, *Growth kinetics, Chemostats, Flagellate algae, Optical density sensor.

This study employed a continuous flow turbidostat and a chemostat to appraise the effect of nitrate-nitrogen concentration on the growth of two strains of Chlorella pyrenoidosa (TX 71105 and Emerson). In one trial a mixture of algae indigenous to San Joaquin Delta (California)--green, green flagellates and diatoms--was used as test organisms. The specific growth rate increased with temperature and concentration of nitrogen. The concentration of nitrate-nitrogen decreased with temperature above 35C. The growth optimum was not necessarily optimum for nitrate utilization. The mixed culture of algae showed substantial specific growth rate at much lower nitrogen concentration than C pyrenoidosa. Results of the study emphasize the wide difference in nitrogen requirements of various algal species. The turbidostatic method proved more expensive, but more advantageous than the chemostatic method. (Wilde-Wisconsin)
W70-10403

5B. Sources of Pollution

JOINT CONFERENCE ON PREVENTION AND CONTROL OF OIL SPILLS.
American Petroleum Inst., New York; and Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-10035

A HISTORY OF MAJOR OIL SPILL INCIDENTS,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Technical Support.
K. E. Biglane.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 5-6, 1970. 2 p.

Descriptors: *Water pollution sources, *Water pollution control, *Water pollution treatment, *Oily water, Oil industry, Ships, Oil wells, Oil-water interfaces, Oil wastes.
Identifiers: Oil spills, Shipwrecks.

The major oil spills of recent years are summarized and some of the causes of these spills and their effects on the environment are discussed. Research needed to control oil spills and domestic and international legislation needed to provide compensation for oil pollution damage are recommended. (See also W70-10035). (Knapp-USGS)
W70-10036

UNITED KINGDOM MINISTRY OF TECHNOLOGY WORK ON OIL POLLUTION,
Warren Spring Lab., Stevenage (England).
For primary bibliographic entry see Field 05G.
W70-10037

MICROBIAL MODIFICATION OF CRUDE OIL IN THE SEA,
Scripps Institution of Oceanography, La Jolla, Calif.
C. E. ZoBell.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 317-326, 1970. 10 p, 84 ref.

Descriptors: *Oily water, *Biodegradation, *Oil, Nutrients, Bacteria, Oxidation, Path of pollutants, Aquatic microbiology.
Identifiers: Oil spills, Oil decomposition.

Hydrocarbons and crude oils are susceptible to microbial oxidation. More than a hundred species of bacteria, yeasts, and fungi are able to oxidize hydrocarbons. Each species is limited in the kinds of hydrocarbons it can attack and also by the temperature, salinity, surface tension, pH, oxygen tension, and other environmental conditions. Oil-oxidizing bacteria are most abundant in coastal waters and mud where oil pollution is chronic. Such bacteria are extremely scarce in the open sea. Bacteria in well-oxygenated waters might oxidize oil at rates ranging from 0.02 to 2 grams per square meter per day at 20 deg to 30 deg C. (See also W70-10035). (Knapp-USGS)
W70-10046

MICROBIAL DEGRADATION OF NORMAL PARAFFIN HYDROCARBONS IN CRUDE OIL,
Florida State Univ., Tallahassee. Dept. of Oceanography.
R. J. Miget, C. H. Oppenheimer, H. I. Kator, and P. A. LaRock.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 327-331, 1970. 5 p, 9 fig, 2 tab, 7 ref.

Descriptors: *Biodegradation, *Oil, *Oily water, Oxidation, Nutrients, Surfactants, Bacteria, Microorganisms, Path of pollutants, Aquatic microbiology.
Identifiers: Oil spills, Oil decomposition.

Experiments were designed to measure the oxidation and degradation of crude oils by naturally occurring marine microorganisms. Fifty active oil degrading cultures were isolated in enriched seawater containing crude oil. Oil degradation was determined with gas chromatography, wet combustion, and by measurement of surface tension. Normal paraffin hydrocarbons through C-26 are degraded by two different groups of microorganisms--those growing in the oil phase only and those growing in the aqueous phase. Emulsification of the crude oil through production of surfactants was observed in many of the enriched cultures. Microbial degradation of 35 to 55% of oxidizable crude oil occurred within 60 hours. (See also W70-10035) (Knapp-USGS)
W70-10047

KINETICS OF DISSIPATION AND BIODEGRADATION OF CRUDE OIL IN ALASKA'S COOK INLET,
Alaska Univ., College. Inst. of Marine Science.
P. J. Kinney, D. K. Button, and D. M. Schell.
Financial support provided by the Western Oil and Gas Association. Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 333-340, 1970. 8 p, 5 fig, 21 ref.

Descriptors: *Biodegradation, *Oil, *Oily water, *Alaska, Oxidation, Nutrients, Bacteria, Aquatic microorganisms, Aquatic microbiology, Path of pollutants.
Identifiers: Cook Inlet (Alaska), Oil spills, Oil decomposition.

The magnitude of oil pollution problems in Alaska's Cook Inlet was studied. Physical dissipation and biodegradation rates were determined and combined with estimates of hydrocarbon input rates to assess the fate of oil. Hydrocarbon accumulation is less than the present limits of detection. Cook Inlet flushing is 90% complete in 10 months. Unsupplemented Cook Inlet water effectively degrades Cook Inlet crude, this biodegradation is essentially complete in the order of a few months and the biodegradation capacity of Cook Inlet is large. Thus biodegradation is more important than physical flushing in removing hydrocarbon pollutants from Cook Inlet. The methods and results are discussed in terms of their applicability to other areas. (See also W70-10035). (Knapp-USGS)
W70-10048

PESTICIDES IN SURFACE WATERS OF THE UNITED STATES--A 5-YEAR SUMMARY, 1964-68,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Analytical Quality Control Branch.
For primary bibliographic entry see Field 05A.
W70-10050

DISPERSAL OF EFFLUENTS IN THE GREAT LAKES,
Waterloo Univ. (Ontario).
G. T. Csanady.
Water Research, Vol 4, No 1, p 79-114, January 1970. 36 p, 34 fig, 32 ref. FWQA Grant No WP-01139-01.

Descriptors: *Dispersion, *Path of pollutants, *Great Lakes, *Currents (Water), Outlets, Waste disposal, Water pollution sources, Water pollution control, Mixing, Jets, Turbulence, Water circulation, Thermal stratification, Lakes, Limnology, Tracers, Tracking techniques, Diffusion, Model studies, Hydraulic models, Mathematical models.
Identifiers: Conservative pollutants.

A comprehensive description is given of the physical factors involved in the dispersal of conservative pollutants in the Great Lakes, based mainly on experimental data obtained in Lakes Huron and Erie over 7 years. Parameters important in small-scale diffusion problems are current speed and effective (eddy) diffusivity. Constant values of these parameters adequately describe the diffusion of individual parcels or plumes of marked fluid, but the appropriate values depend on turbulence intensity, which is in turn dependent on thermal stratification. On a larger scale, the meandering of effluent plumes becomes an important dispersal mechanism. With some meandering, however, effluents discharged near shore almost always generally follow the shorelines, apparently in response to the lake-wide flow pattern which is believed to be characterized by coastal jets near

shores and (at least during the summer periods) oscillating currents in the central portions. The resulting phenomenon of coastal entrapment of pollutants leads, for a near-shore source, to the formation of a relatively heavily polluted influence region of typically perhaps 25 km extent either side of the source. (Knapp-USGS)
W70-10051

FLOW FROM A SPHERICAL SOURCE WITH WATER CONTENT DEPENDENT DIFFUSIVITY,
San Jose State Coll., Calif.
Rameshwar Singh.
Water Resources Research, Vol 6, No 4, p 1140-1147, August 1970. 8 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Diffusion, *Soil water movement, *Radioactive wastes, Equations, Groundwater movement, Leaching, Mathematical models, Mixing, Radioactive waste disposal, Unsaturated flow, Saturated flow, Adsorption, Adsorption, Ion transport.
Identifiers: Spherical diffusivity.

Leakage of moisture from underground buried sources can occur because of cracking or deterioration of containers. Leaking moisture can be radioactive or contaminated and may endanger public health. In disposal of such substances underground, consideration must be given to the extent of dispersal of moisture from wet containers in case of accidents. The movement of moisture from a spherical buried source into partially saturated surroundings is described by a nonlinear partial differential equation. Complexity of the equation prevents obtaining an explicit solution of the problem; however, an approximate solution may be extracted by the method of weighted residuals. The technique calls for representing the solution with a polynomial in space variable that has its coefficients as unknown functions of time, to be determined from the conditions and by satisfying the equation by averaging over the range of space-variable. This procedure accepts any kind of diffusivity function including numerical values obtained from experiments. The method is simple in its application and produces results that compare well with the known solution. (Knapp-USGS)
W70-10058

THE RELATIONSHIP BETWEEN DISSOLVED NUTRIENT SALTS AND PROTEIN PRODUCTION IN SUBMERGED AUTUMNAL LEAVES,
Waterloo Univ. (Ontario).
For primary bibliographic entry see Field 02K.
W70-10163

AGRICULTURE CHEMICALS AND OUR WATER RESOURCES,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Edwin J. Monke, and Philip R. Goodrich.
Agricultural Engineering, Volume 51, No. 6, p. 358, June 1970.

Descriptors: *Agricultural chemicals, *Nitrates, *Pesticide residues, Activated carbon, Storm runoff.
Identifiers: *Bio-environmental control, Methemoglobinemia, Cynanosis.

Although bio-environmental control has been suggested as an alternative to pesticide usage, agrochemical usage can be made safe to the environment by good management. Pesticides are being blamed for contamination of water on a large scale, but pesticide pollution occurs mainly from land runoff or from polluting manufacturing processes. Agricultural engineers are also faced with the problem of developing methods to alleviate pollution caused by nitrate fertilizers. The long held idea that deep wells could satisfactorily counter the ill effects from nitrate leaching has proven to be unacceptable. (Holmes-Rutgers)
W70-10185

OXYGEN DYNAMICS IN THE THERMAL MIXING ZONE,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Chemical Engineering.
R. C. Ahlert, and D. Nochumson.
Fifth International Water Pollution Research Conference, San Francisco, July 26-Aug 1, 1970. Preprint, 14 p, 10 fig, 1 tab, 25 ref.

Descriptors: *Thermal pollution, *Mixing, Dispersion, Reaeration, Mathematical models, Diffusion, Velocity.
Identifiers: Equilibrium index, Oxygen dynamics, Reaction rate constant.

A conventional, one-dimensional model of oxygen dynamics is not satisfactory for that stretch of a river downstream of a thermal outfall, which can be characterized as the mixing zone. The oxygen dynamics of the mixing zone have been analyzed on the basis of interfacial reaeration and carbonaceous biological oxygen demand. Great care must be taken in sampling thermal and material quality of stream in regions that involve interaction between thermal and material outfalls. Regions of stratification and channeling can be expected downstream of some outfalls. The combination of thermal dispersion processes, both chemical and biological reactions and transport processes at the interface can yield results totally unpredicted by one dimensional modelling. Of particular importance is the capacity of this technique to predict the point at which limited sampling downstream of one or more outfalls becomes a possible basis for stream quality management involving both physical and/or legal control. (Upadhyaya-Vanderbilt)
W70-10208

ACTIVABLE RARE EARTH ELEMENTS ESTUARINE WATER TRACERS,
Stanford Univ., Calif. Dept. of Civil Engineering; and Public Health Service San Francisco, Calif.
For primary bibliographic entry see Field 05A.
W70-10210

PLUME LENGTHS PREDICTED MATHEMATICALLY.

Electrical World, May 4, 1970. 39 p, 1 fig, 1 tab.

Descriptors: *Cooling towers, Thermal pollution, Dispersion, Computer programs.
Identifiers: *Plume lengths.

Kaylor and associates used a mathematical model developed for stack dispersion studies and adapted it for cooling-tower use. A Stone and Webster computer program called CLOUD was developed to use psychrometric charts, and the Pasquill-Turner stability classes. The program input requires a water-vapor emission rate from a cooling tower, tower height and diameter, wind speed, stability classes, downwind distances and relative humidities with corresponding ambient dry-bulb temperatures. The output includes the values of the visible plume lengths at the specified conditions. The predicted plume lengths were, on the average, 21% higher than the observed values. Neglect of plume rise is probably the cause of the somewhat higher predicted values. (Upadhyaya-Vanderbilt)
W70-10220

CONDITIONS OF RECIRCULATION OCCURRENCE AT COOLING WATER INTAKE (In Polish),
Adam Widomski.
Gospodarka Wodna, 1970, No 1, p 3-7. 11 fig, 5 ref.

Descriptors: *Cooling, Streams, *Thermal powerplants, *Heat balance, Thermal stratification, *Thermal pollution, Temperature, Water temperature, Thermal conductivity.

Experimental investigations concerning some river sectors in the vicinity of warm water outflow in power plants have been carried out in models under the conditions of plant operation. Current directions and the occurrence of recirculation have been perceived. The recirculation is dependent on the Froude number, the quantity of water taken up from rivers and the distance between the points of the water outlet and the water intake. The results of the investigations enable estimations of the limit conditions of the occurrence of recirculation and its consequences for cooling water intake from streams. Significant stratification in streams has been observed. For regular river channels the occurrence of the recirculation can be described by the following: Froude number, the intake-outlet nondimensional ratio delta L/B where B is width of stream, and nondimensional flow ratio Qu/Qo where Qu is the cooling water intake rate and Qo is the original flow in the river. (Novotny-Vanderbilt)
W70-10222

ANALYSIS TECHNIQUES FOR HOUSTON SHIP CHANNEL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
Roy W. Hann, Jr.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW 2, Paper 7258, p 171-180, May 1970. 10 p, 9 fig, 1 ref.

Descriptors: *Path of pollutants, Estuaries, *Bays, *Currents (Water), *Tides, Water pollution sources, Saline water intrusion, Stratified flow, Stratification, Water quality, Hydraulic models, Computer models, Dispersion, Surveys, Sampling.
Identifiers: Houston Ship Channel (Texas).

The environmental pollution problems of the Houston Ship Channel are defined and the broad program to provide analytical management tools is presented. Methodology is presented for the evaluation of the tidal mass water movement and for the evaluation of the density current couple which is superimposed on the tidal mass movement. Degree of Stratification is defined and its value discussed. The basic philosophy of the steady model with provisions for stratified analysis presented and preliminary results are displayed. The field program being carried out by Texas A and M University to provide data for the verification of the presented methods and for more elaborate methods yet to be developed is outlined. (Knapp-USGS)
W70-10266

USE OF ISOTOPIC DECAY RATES IN TURBULENT DISPERSION STUDIES,
Weizmann Inst. of Science, Rehovoth (Israel).
M. Beran, and G. Assaf.
Journal of Geophysical Research, Vol 75, No 27, p 5279-5285, September 20, 1970. 7 p, 3 fig, 16 ref.

Descriptors: *Radioactivity techniques, *Diffusion, *Dispersion, *Turbulent flow, Mixing, Tracers, Path of pollutants, Analytical techniques, Radioisotopes, Radioactive dating, Radioactivity.
Identifiers: Isotopic decay rates.

The differences in isotopic decay rates can be used to determine information about time-dependent turbulent dispersion from steady-state measurements. Mean horizontal transport results from vertical turbulent dispersion coupled with a mean horizontal wind that has a vertical gradient. Applications to atmospheric and oceanographic conditions are discussed. If it is possible to measure the steady-state vertical concentration gradient resulting from an infinite plane source, the time-dependent vertical concentration distribution resulting from an instantaneous point source can be calculated. This information can then be used to determine the mean horizontal transport. Atmospheric dispersion of natural isotopes emanated from the ground is discussed in the context of this solution. (Knapp-USGS)
W70-10268

TRITIUM IN CRATER LAKE, OREGON,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
H. James Simpson.
Journal of Geophysical Research, Vol 75, No 27, p 5195-5207, September 20, 1970. 13 p, 5 fig, 9 tab, 20 ref. AEC Grant AT (30-1) 2493.

Descriptors: *Tritium, *Fallout, *Lakes, *Craters, Hydrologic budget, Water balance, Seepage, Evaporation, Hydrogeology, Mixing, Precipitation (Atmospheric), Sampling.
Identifiers: Crater Lake (Oregon).

Input by precipitation can explain most of the tritium content of Crater Lake, Oregon. The hydrology of Crater Lake makes it ideal for this study because less than 1/2 of 1% of the lake volume is lost from the lake by vapor exchange because the surface concentration is diluted by vertical mixing. If Crater Lake has retained nearly all its input tritium, and if less than half of this input was supplied by vapor exchange as derived from budget calculations, deep lakes with small drainage basins can provide good estimates of the total tritium rainout. (Knapp-USGS)
W70-10269

A REVIEW OF CHLORINATED BIPHENYL CONTAMINATION IN NATURAL WATERS,
Wisconsin Univ., Madison, Water Chemistry Lab.
Gilman D. Veith, and G. Fred Lee.
Water Research, Vol 4, No 4, p 265-269, April 1970. 5 p, 28 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Organic compounds, *Pollutant identification, *Reviews, *Water pollution sources, Chromatography, Gas chromatography.
Identifiers: Chlorinated biphenyls.

A review of the present state of knowledge concerning environmental contamination by organochlorine compounds indicates that the chlorinated biphenyls may be one of the more widespread contaminants. The significance of this contamination has not yet been evaluated due, in part, to the lack of systematic analytical procedures for the quantitative and qualitative determinations of the components of chlorinated biphenyl mixtures. The possibility of the chlorinated biphenyls producing serious errors in chlorinated pesticide analyses is emphasized. (Knapp-USGS)
W70-10277

AN ECONOMIC MODEL FOR A POLLUTED RIVER SYSTEM,
V. K. Collinge, D. H. Newsome, A. L. Downing, and J. Renold.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-6. 7 p.

Descriptors: *Mathematical models, *Dissolved oxygen, *Biochemical oxygen demand, *Water quality, *Pollution abatement, Water pollution control, Chlorides, Economic benefits, Ammonia.

The river Trent in England is undergoing an extensive systems analysis, in order to derive technical and economic solutions to its severe pollution problems. The river's tributary, the Tame, drains the Birmingham industrial area with a population of 2.1 million. The Trent River authority needs to develop additional water supplies from the river. The economic modelling requires quantitative relationships between cost, quality, quantity, use and benefit. A key concept is 'quality state', meaning an ordered set of concentrations of water quality constituents. (This appears similar to term 'objective sets' used by Delaware River Basin Commission). Substances such as chlorides and suspended solids are found to act conservatively but BOD, dissolved oxygen and ammonia were analyzed using the Streeter-Phelps relationships. Dynamic programming has been chosen for the mathematical modelling, considering the river to consist of a number of reaches or stages. Methods of evaluating benefits of various quality states are being worked out. (Whipple-Rutgers)
W70-10370

WATER QUALITY AND MANAGEMENT EXPERIENCES OF THE DELAWARE RIVER BASIN COMMISSION,
Delaware River Basin Commission, Trenton, N.J.
J. F. Wright, and R. Porges.
Fifth International Water Pollution Research Conference, San Fracisco, July 26-August 1, 1970. Preprint, Paper I-3. 17 p.

Descriptors: *Mathematical models, *Dissolved oxygen, *Biochemical oxygen demand, *Water quality, *Pollution abatement, Water pollution control.
Identifiers: Objective sets, Water quality enforcement zones, BOD allocation.

Although technical aspects of water quality control are within our grasp, and general public support is available, there remain knotty public policy problems to be solved. Experiences of the Delaware River Commission should aid in solving these problems. The mathematical modelling of the biochemical oxygen demand regimen of the Delaware estuary represents the primary pollution problem of the basin. This modelling, originally accomplished by a steady-state assumption has now been elaborated into a time varying model more representative of tidal flows. With the use of this model, costs may be obtained of various alternative sets of standards, called objective sets. In terms of detailed implementation, the ideal least cost solutions proved impracticable; standards are therefore set by zones, and each facility is given an allocation in terms of primary BOD. As implementation of these controls continues, principles and procedures are being developed which should be applicable in other basins. (Whipple-Rutgers)
W70-10371

NITRIFICATION IN TREATMENT PLANTS AND NAUTRAL WATERS: SOME IMPLICATIONS OF THE THEORETICAL MODELS,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05D.
W70-10388

LOGGING ROADS AND WATER QUALITY,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-10417

WATER POLLUTION AND THE TEXTILE INDUSTRY,
For primary bibliographic entry see Field 05D.
W70-10427

REAMS V CITY OF LONDON (SUIT FOR DAMAGES TO PROPERTY CAUSED BY POLLUTION OF A STREAM).
For primary bibliographic entry see Field 06E.
W70-10439

STONE V CITY OF ASHLAND (CITY'S LIABILITY FOR WATER POLLUTION FROM MUNICIPAL SEWERS).
For primary bibliographic entry see Field 06E.
W70-10440

THE PANAM (LIBEL FOR THE DISCHARGE OF OIL INTO COASTAL NAVIGABLE WATERS).
For primary bibliographic entry see Field 06E.
W70-10442

SHUSTER V CITY OF CHISHOLM (LIABILITY FOR POLLUTION OF STREAM).
For primary bibliographic entry see Field 06E.
W70-10444

DOLLAR SS CO V UNITED STATES (DISCHARGE OF REFUSE INTO NAVIGABLE WATERS).

101 F2d 638-640 (9th Cir 1939).

Descriptors: *Hawaii, *Water pollution, *Ships, *Waste disposal, Legislation, Pollutants, Water pollution control, Water pollution sources, Judicial decisions, Legal aspects, Navigable waters, Admiralty, Harbors, Flotsam, Federal government, United States, Regulation.

Plaintiff United States brought libel against defendant vessel under a federal statute which prohibits the discharge of refuse into navigable waters of the United States. Defendant threw garbage into Honolulu harbor by its agent; however, defendant had attempted to prevent the discharge, and proved at trial that the discharge was unintentional and not for want of due care. Defendant contended that the unintentional discharge did not violate the statutory prohibition. The court ruled that the wording of the statute did not require intent or lack of due care for liability, being simply a prohibition of refuse discharge with an accompanying sanction. Interpreting the statute as holding any vessel strictly liable for refuse discharge, the court affirmed the decision of the lower court for plaintiff. (Hart-Florida)
W70-10462

5C. Effects of Pollution

BLUE-GREEN ALGAL BLOOMS IN SASKATCHEWAN LAKES,
Saskatchewan Univ., Saskatoon.
For primary bibliographic entry see Field 02H.
W70-10165

THE EFFECT OF SOME ECOLOGICAL FACTORS ON BACTERIA IN WATER,
Institute of Experimental Hygiene, Bratislava (Czechoslovakia). Dept. of Water Hygiene.
Imrich Daubner.
Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 731-743, 1969. 10 fig, 10 ref.

Descriptors: *Water pollution effects, *Ecology, *Bacteria, *Water, Enteric bacteria, Sampling, Clostridium, Actinomycetes, Plankton, Temperature, Flow rates, Water pollution, Water quality, Turbulence, Sedimentation, Viruses, Bacteriophage, Trophic level, Indicators, Microbiology, Microscopy, Laboratory tests.
Identifiers: *Enterobacteriaceae, Danube River, Enterococci, Ammonizing bacteria, Leptospirae, Microbial plankton, Anaerobic sporulating clostridia, Beet-sugar, Austria, Moravia, Fecal pollution.

A study of regularities in number of microbes in water in the course of the year under the influence of physical, chemical, and biological factors in natural biotope and also of some chosen phenomena in laboratory experiments is described. Factors influencing survival of bacteria of the family Enterobacteriaceae in water in a positive and negative sense are evaluated with the objective to utilize natural elements of the water medium--bacterial antagonism--resulting in prompt elimination of bacteria from water. For indicators of fecal contamination of water (using membrane filters) the number of colonies of Enterobacteriaceae, enterococci, and anaerobic sporulating clostridia are determined. A major ecological factor influencing bacteria numbers in water is flow-rate per second. In biotope investigated, total count of microbes is in inverse proportion to water flow-rate. A reverse

correlation to flow-rate is shown also by heterotrophic bacteria cultivated at 20C and 37C, as well as the determined indicators of fecal contamination, Enterobacteriacea, enterococci, and anaerobic sporulating clostridia. While in the case of Enterobacteriaceae a positive correlation exists, relationships between the number of enterococci and clostridia to the temperature is reversely proportional. (Jones-Wisconsin)
W70-10169

THE GENERAL ANALYSIS OF A EUTROPHIC SYSTEM,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-10170

SOME EFFECTS OF ORGANIC WASTES ON AQUATIC INSECTS IN IMPOUNDED HABITATS,
Louisiana State Univ., Baton Rouge. Dept. of Entomology., and Louisiana State Univ., Baton Rouge. Dept. of Microbiology.
C. D. Steelman, and A. R. Colmer.
Annals of the Entomological Society of America, Vol 63, No 2, p 397-400, 1970. 3 tab, 4 ref.

Descriptors: *Water pollution effects, *Organic wastes, *Aquatic insects, Habitats, Impounded waters, Coliforms, Mosquitoes, Lagoons, Indicators, Livestock, Water pollution sources.
Identifiers: Swine, Lagoon studies, Culex pipiens quinquefasciatus, Escherichia coli, Escherichia freundii, Escherichia intermedia, Aerobacter aerogenes, Coptotomus, Hydrous triangularis, Chironomus plumosus, Chaoborus, Brachydeutera, Musca domestica, Psychoda, Hermetia illucens, Stratiomys, Eristalis aeneus, Tabanus, Odonata.

The relative effects of organic waste pollution on the aquatic insect fauna of a freshly dug livestock waste disposal lagoon was studied. Introduction of organic waste material from swine pens into impounded aquatic habitat caused suppression of certain insect species. Decreases in aquatic insect fauna paralleled the increase in the organic waste concentration determined by changes in the numbers of coliform bacteria. The southern house mosquito, Culex pipiens quinquefasciatus Say, began laying eggs in the lagoon when coliform counts approximated 7000 organisms per milliliter of lagoon water. Water suspensions of pure cultures of coliforms Escherichia coli, E freundii, and E intermedia were found to be more attractive as oviposition sites for C p quinquefasciatus than water suspensions of Aerobacter aerogenes or sterile water. The change in insect fauna in the new lagoon during the 2-1/2 years' study was considered to be directly related to the change in the organic waste pollution of the water. The data obtained indicate the possibility of using aquatic insects as biological indicators of water quality. (Jones-Wisconsin)
W70-10171

MANAGEMENT OF AQUATIC VASCULAR PLANTS AND ALGAE,
Cornell Univ., Ithaca, N.Y. Dept. of Botany.
For primary bibliographic entry see Field 02I.
W70-10175

EUTROPHICATION SPEEDED BY MAN,
Richard H. Gilluly.
Science News, Vol 98, No 1, p 17-19, July 4, 1970. 4 fig.

Descriptors: *Eutrophication, *Phosphorus, *Nitrogen, Sewage disposal, *Detergents.
Identifiers: *Lake Washington, Lake Tahoe, Lake Erie, Lake Monona, Lake Sebasticook, Secchi Disk.

Disposal of intolerable amounts of phosphorus and nitrogen are speeding up the eutrophication process of lakes in North America and throughout the world. These nutrients stimulate plant growth and turn the lake into a marshy foul-smelling, fish killing, oxygen lacking body of water. A great deal of this accelerated eutrophication is the direct result of sewage disposal into the lakes. Detergent phosphates and nitrates are also potent accelerating forces. Although the causes have been identified, the cure is often very difficult to administer because of political and economic obstacles. The 'most obvious' solution is to divert sewage to another outlet or to subject it to tertiary treatment. (Holmes-Rutgers)
W70-10181

COOLING-TOWER EFFECTS: STUDIES ABOUND,
IIT Research Inst., Chicago, Ill.
E. Aynsley.
Electrical World, May 11, 1970, p 42-43. 3 fig.

Descriptors: *Cooling towers, Humidity, Precipitation (Atmospheric), *Environmental effects.
Identifiers: Keystone generating station, Stack gases, *Climatic conditions.

There is some apprehension today that cooling-tower emissions may produce undesirable environmental effects. Inadvertent weather effects, including local fogging and icing, cloud formation, and increased precipitation are often cited as possibilities. Initial results from ground and aerial studies being conducted by IIT Research Institute of Chicago at 1800-Mw, Keystone Generating Station indicate that no immediate problems appear to exist. There were 16 towers operational at the end of 1969 in U.S. Current projections indicate 33 towers within the next two years. Measurements of cooling-tower plume profiles indicate that humidity increases can be detected for many miles downwind. Little information is currently available concerning cumulus-cloud initiation, and it is hoped to gather further information in this area. Keystone burns 600 tons per hour of coal, which gives rise to some 20 tons per hour of SO2 emitted in the stack gases. (Upadhyaya-Vanderbilt)
W70-10218

WASTE HEAT DISPOSAL FROM POWER GENERATING STATIONS,
Federal Power Commission, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-10219

EFFECTS OF CLEAR-CUTTING ON STREAM TEMPERATURE,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 04C.
W70-10248

BIOLOGICAL SYSTEMS AS POLLUTION MONITORS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 05A.
W70-10273

MERCURY IN GREAT LAKES FISH,
Bureau of Commercial Fisheries, Ann Arbor, Mich.
Harry L. Seagran.
Linnos, Vol 3, No 2, p 3-10, 1970. 2 fig.

Descriptors: Heavy metals, *Great Lakes, *Public Health, Water pollution effects, Water pollution sources, Fish harvest, Inspection, Legal aspects, *Monitoring, On-site investigations, Industrial wastes, Pulp and paper industry, Pulp wastes, Economic impact, Lake Huron, Lake Erie.
Identifiers: *Recommendations, *Mercury, Fishing closures, Chlor-alkali plants, Minamata disease, St. Clair River.

This article summarizes statements by public agencies and the private sector dealing with mercury contamination introduced before the Subcommittee on Energy, Natural Resources and the Environment of the Senate Committee on Commerce. The development of the current situation, sources of contamination, background on mercury contamination, economic assessment of losses due to mercury contamination, a description of current BCF research, and a list of recommendations are discussed. The recommendations stress the need to identify all sources of mercury pollution and determine the fate and toxic effects of mercury in the environment. (See also W70-10322) (Katz-Washington)
W70-10321

THE MERCURY THREAT: QUESTIONS TO CONSIDER,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
Richard Copeland.
Limnos, Vol 3, No 2, p 11-13, 1970. 2 fig.

Descriptors: Heavy metals, *Great Lakes, Lake Erie (Geochemistry), Trace elements, Water pollution sources, Water pollution effects, Fungicides, Regulations, Lethal limit, Industrial wastes, Pulp and paper industry, *Pulp wastes, *Food chains, *Path of pollutants, *Public health persistence.
Identifiers: *Mercury pollution, Lake St. Clair, Chlor-alkali plants, Minamata disease, *Concentration mechanisms.

This paper discusses the basics of the mercury pollution problem. Mercury is used in industry in two forms, metallic mercury as an electrode in the production of chlorine and alkalis, and organic mercury compounds. The latter are as slimicides used in the pulping industry. Mercury is incorporated and accumulated in fish in two ways. Via the gills as an equilibrium is set up between mercury in fish and water. The second method is ingestion of mercury contaminated food. The author gives a calculated guess as to how long a mercury polluted environment will stay polluted after stopping mercury input. In the case of the Lake Erie - St. Clair system an estimate of 10-100 years is given. (See also W70-10321) (Katz-Washington)
W70-10322

A SHORT HISTORY OF MINAMATA DISEASE RESEARCH AND THE PRESENT SITUATION OF MERCURY POLLUTION IN JAPAN,
Tokyo Univ. (Japan). Dept. of Sanitary Engineering.
Jun Ui.
Nordiskt symposium Kring Kvicksilverproblematiken, held in Lidingo, Sweden, 10-11, Oct. 1968, No 2, Band 50, 1969, Nordiskt Hygienisk Tidskrift, p 139-146. 20 ref, 4 fig.

Descriptors: *Public health, Heavy metals, History, Industrial wastes, On-site investigations, Water pollution effects, Water pollution sources, Fungicides, Toxicity, Diseases.
Identifiers: *Minamata disease, *Mercury pollution, Japan, Acetaldehyde synthesis, Disease symptoms.

The discovery of Minamata Disease and its cause are documented. It is caused by consuming fish and shellfish which contain low-molecular normal alkyl mercury. The source of mercury pollution was the Minamata Factory which used mercury in the acetaldehyde synthesis process. The symptoms of the disease, mainly impairment of motion, speech, sensation, vision, and hearing are described and quantified. The Japanese have realized their problem and are now trying to alleviate all mercury pollution. (Katz-Washington)
W70-10323

COPPER, IRON, MANGANESE, AND ZINC CONTENT OF OYSTER (CRASSOSTREA ANGULATA) FROM THE COASTS OF CADIZ (IN SPANISH),
Instituto de Investigaciones Pesqueras, Cadiz (Spain).

Rafael Establier.
English summary. Investigacion Pesquera, Vol 33, No 1, p 335-343, 1969. 3 tab, 2 fig, 5 ref.

Descriptors: *Copper, *Iron, *Manganese, Heavy metals, Oysters.
Identifiers: *Zinc, *Crassostrea Angulata Spain, Cadiz coast, Cadiz Bay.

Oysters from the area around Sanlucar de Barrameda have a high concentration of Cu and Zn, whereas those from Cadiz Bay, Sancti-Petri, and Barbate contained less Cu and Zu than did the others. The average concentration of Cu, Fe, Mu and Zu in the oysters from various localities is tabulated. (Katz-Washington)
W70-10324

THE EFFECTS OF INDUSTRIAL WASTES OF MEMPHIS AND SHELBY COUNTY ON PRIMARY PLANKTONIC PRODUCERS,
Christian Bros. Coll., Memphis, Tenn.
R. Staub, J. W. Appling, A. M. Hofstetter, and I. J. Haas.
Bio Science, Vol 20, No 16, p 905-912, 1970. 4 fig, 3 tab, 10 ref.

Descriptors: *Water pollution effects, *Industrial wastes, Tennessee, Mississippi River, *Bioindicators, *Plankton, Diatoms, Correlation analysis, Phytoplankton, Chlorides, Chromium, Hardness (Water), Environmental effects, Biochemical oxygen demand, *Water temperature, Hydrogen ion concentration, Dissolved oxygen, Carbon dioxide, Silica, Turbidity, Manganese, Iron, Copper.
Identifiers: Memphis, Sky cover, Pennate counts, Centric counts, Diversity indexes.

Use of plankton analysis as an indicator of degree of pollution in a complex aquatic community is a promising area of investigation because of the role of plankton as primary producers. Correlation studies have indicated that water temperature is the major controlling influence in regulating both kinds and numbers of individuals. The iron content of the water samples surveyed had the next highest correlation with plankton numbers, and it was a consistently negative correlation. Turbidity of the waters sampled likewise showed considerable negative correlation with numbers of plankton. Total hardness (calcium and magnesium) and chloride content showed good correlation with numbers of plankton positive organisms. No significant correlations were found for copper, carbon dioxide, and chromate content of the water with or sky cover in relation to number of organisms. Very few significant correlations were obtained for dissolved oxygen, manganese or silica content, or for pH. However, given a sufficient run, or flow, through relatively nonpolluting regions, and a natural dilution (increase in volume), a stream can greatly improve its quality by development and activity of its plankton community. (Katz-Washington)
W70-10325

HEMATOLOGICAL EFFECTS OF APHOLATE ON CHANNEL CATFISH (ICTALURUS PUNCTATUS),
Mississippi Univ., Jackson. Dept. of Biochemistry.
Charles L. Dodgen, and Sue Sullivan.
Proceedings of the Society for Experimental Biology and Medicine, Vol 131, p 124-126, 1969. 10 ref, 2 tab. USPHS Grants EF 00438, ES 00137, and CC 00271.

Descriptors: *Channel catfish, Fishkill, *Fish physiology, Bioassay, Toxicity, Lethal limit, Mode of action.
Identifiers: *Apholate, Alkylating agents, *Hematological effects, Erythrocyte counts, Leukocyte counts, Thrombocytes, *Blood cell counts, Histological examination.

Channel catfish fingerlings were given oral doses of apholate, 200 mg/kg and 400 mg (Apholate/kg body weight), an alkylating agent. Total erythrocyte, total leukocyte, and differential leukocyte counts were made to determine hematological changes produced by apholate. The changes in erythrocyte counts of animals receiving apholate at both levels were not significantly different from the control. The total leukocyte counts were significantly lower in the treated fish. There was less of an effect upon the thrombocytes. The lower dose used in the experiments approximates the LD50 of 191 mg/kg, determined at 14 days post-treatment. The LD50 decreases to 124 mg/kg at 30 days, but no deaths occurred in less than 8 days, regardless of dose. (Katz-Washington)
W70-10327

ESTUARINE MEASUREMENTS FOR PRODUCTIVITY AND EVALUATION OF SYSTEM WASTE DISCHARGE EFFECTS,
Texas Univ., Austin.
E. M. Davis, and W. W. Eckenfelder.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint. 9 p, 6 fig, 2 tab, 10 ref.

Descriptors: *Estuaries, *Productivity, *Photosynthesis, *Respiration, Water pollution effects, Chlorophyll, Diurnal distribution, Dissolved oxygen.
Identifiers: Species diversity index.

The overall productivity of two estuarian systems on the Texas coast, namely Taylor Bayou and Chocolate Bayou, was evaluated and the seasonal effects of chemical waste discharges on the ecology of the systems was estimated. The variation of productivity by season of the year over a two-year period was established by field analysis which included the measurement of gross photosynthesis and respiration and the species diversity index in each system. These results were compared to laboratory data using waste samples taken from each estuary. It was established that the community productivity and the effects of additions of chemical process wastes could be determined under laboratory conditions. Chlorophyll-a response varies with the population quite extensively and can increase due to phytoplankton increases. The nutritive benefit is therefore quite rapid for some wastes. Even with increases of chlorophyll-a concentrations some photosynthetic supression may occur due to a concurrent toxic effect by the waste. Diversity indexes decreased most often due to the toxic effect of the wastes on the zooplankton. The dinoflagellates are more seriously effected, followed by the green algae, diatoms then bluegreens. Application of the principles involved herein are by no means limited to the estuaries of Texas coast, and may be applied to any aquatic ecosystem regardless of the hemisphere in which it is located. (Hancuff-Texas)
W70-10401

NUTRIENT REGENERATION IN LAKES AND OCEANS,
Georgia Univ., Athens. Dept. of Zoology.
R. E. Johannes.
Advances in microbiology of the sea, Academic Press, New York, 1968. Vol 1, p 203-213. 1 fig, 1 tab, 68 ref.

Descriptors: *Nutrients, *Lakes, *Oceans, *Organic matter, *Decomposing organic matter, Nitrogen, Phosphorus, Aquatic plants, Aquatic animals, Ecosystems, Food chains, Zooplankton, Bacteria, Detritus, Herbivores, Carnivores, Phytoplankton, Georgia, New York, Rhode Island, Metabolism.
Identifiers: *Nutrient regeneration, Long Island (N Y), Doboy Sound (Ga), Narragansett Bay (R I), Cayuga Lake (N Y), Cape Breton Island (Canada).

Nutrient regeneration is defined as the release of soluble organic or inorganic plant nutrients by or from organisms or their remains. This discussion is limited to nitrogen and phosphorus. It has been demonstrated that most nitrogen and phosphorus incorporated into aquatic plants and animals is usually regenerated by processes other than direct bacterial action. Nutrient regeneration rates and bacterial numbers are not correlated. Bacteria are instrumental in nutrient regeneration indirectly by converting detritus into a form utilizable by bacteria-feeders. It is these bacteria-feeders which appear to accomplish much of the nonautolytic regeneration of nutrients from detritus. Pathways of phosphorus and nitrogen flow in aquatic ecosystems are generally dominated by grazing food chains; much of the phosphorus and nitrogen assimilated by plants is subsequently ingested, metabolized and released in soluble forms by zooplankton. A substantial remainder is released from organiz detritus by autolysis and solution. Bacteria facilitate nutrient regeneration from residue by assimilating detrital nutrients, thus rendering them available to bacteria-feeders which subsequently excrete them. Bacteria appear to account directly for only a minor fraction of nutrient regeneration and at times actually compete with plants for nutrients. (Jones-Wisconsin)
W70-10404

THE EXTENT OF NITROGEN AND PHOSPHORUS REGENERATION FROM DECOMPOSING ALGAE,
Kentucky Univ., Lexington. Dept. of Civil Engineering; Texas Univ., Austin. Dept. of Civil Engineering; and Stanford Univ., Calif. Dept. of Environmental Engineering.
E. G. Foree, W. J. Jewell, and P. L. McCarty.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint. 15 p.

Descriptors: *Eutrophication, *Algae, *Decomposing organic matter, Nutrients, Surface waters, Nitrogen, Water quality, Phosphorus, Aerobic conditions, Anaerobic conditions, Chlorella, Chlamydomonas, Scenedesmus, Effluents, Oxidation lagoons.
Identifiers: San Pablo Estuary (Calif), Sacramento River (Calif), Searsville Lake (Calif), San Joaquin River (Calif), Nitzschia.

Decomposition of monospecific and heterogenous algae and subsequent release of nutrients were investigated in dark-aerobic and dark-anaerobic cultures. Under aerobic conditions, 50% on the average of the initial particulate nitrogen and phosphorus were regenerated, but the recovery varied from zero to nearly 100%. Under anaerobic conditions, the average regeneration of nitrogen and phosphorus was 40% and 60%, respectively, with variation nearly as great as that for aerobic decomposition. A general agreement between equation-predicted nitrogen and phosphorus refractory values and measured values was obtained. The results suggest that chances for a successful control of eutrophication are much greater before refractory remains of algae have been permitted to accumulate. (Wilde-Wisconsin)
W70-10405

DE ROCHE V OSBORNE (POLLUTED WATER EVEN WITHOUT CONTAMINATED CLAMS JUSTIFIES CLOSING CLAM BEDS TO COMMERCIAL DIGGING).
For primary bibliographic entry see Field 06E.
W70-10448

5D. Waste Treatment Processes

MICROBIAL RELEASE OF SOLUBLE PHOSPHATE IN AN ACTIVATED SLUDGE ENVIRONMENT,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
Clifford W. Randall.
Available from NTIS as PB-194 453, $3.00 in paper copy, $0.65 in microfiche. Completion Report, August, 1970. 10 p, 6 ref. OWRR Project A-024-VA (1).

Descriptors: *Water pollution control, *Waste water treatment, *Biological treatment,

*Phosphates, *Phosphorus, Oxygen, Sewage effluents, Sludge, *Activated sludge, Hydrogen-ion concentration, Oxidation-reduction potential.

Batch type laboratory units were used to study the mechanisms and factors that determine the amount of soluble phosphate that will be released from activated sludge during typical plant operation. In addition to studying the effect of typical operational factors such as rate and duration of aeration, organic loading rate, and duration of anaerobiosis, emphasis was placed on determining whether activated sludge phosphate release is primarily a chemical or a biological phenomenon. The experimental results demonstrate that the release of soluble phosphate from activated sludge is basically a biological phenomenon and that it is relatively independent of the chemical environment as measured by pH and ORP, within the normal range of waste treatment operation. Such release is a strong function of parameters that affect cellular metabolism such as D.O. The release of phosphate occurs under both aerobic and anoxic conditions but the amount released during anoxia is considerably greater and it is released much more rapidly. The magnitude and rapidity of release under any conditions is directly proportional to the biological stress imposed on the system. Release during anoxia can be retarded by preceding high aeration rates and significant amounts of organic substrate.
W70-10112

ENHANCEMENT OF WATER QUALITY USING FOREST-DERIVED COAGULATING SYSTEMS. PART I. THE COAGULANT AND DISPERSANT CHARACTERISTICS OF LIGNOSULPHONATES,
Washington Univ., Seattle. Inst. of Forest Products.
G. G. Allan, and D. D. Halabisky.
Pulp and Paper Magazine of Canada, Vol 71, No 2, p T50-T56, January 16, 1970. OWRR Project A-019-WASH.

Descriptors: *Wastewater treatment, *Water quality, *Pulp wastes, Lignins, Kaolimite, Pulp and paper industry, *Coagulation.
Identifiers: Lignosulfanates.

Lignosulphonates isolated directly from pulp waste liquor are shown to function as dispersants or coagulants depending on their molecular weight. The high molecular weight material (i.e., equal or greater than 0.15 dl./g.), in association with alum is a more effective combination for the removal of colloidal pollutants from water than alum alone. Coagulation mechanisms are discussed, and evidence is presented to show that after reduction of the zeta potential of the contaminant particles by the alum, the large lignosulfonate macromelecules create fast settling flocs by interparticular bridging. (See also W70-10115)
W70-10116

NITRATE REMOVAL FROM ACTIVATED SLUDGE SYSTEMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
Dale A. Carlson.
Available from NTIS as PB-194 457, $3.00 in paper copy, $0.65 in microfiche. Completion Report, July 15, 1970. 35 p, 7 tab, 7 fig, 37 ref. OWRR Project A-026-WASH (1).

Descriptors: *Nitrification, *Denitrification, Water quality control, Eutrophication, *Activated sludge, *Waste water treatment.
Identifiers: *Nitrate removal.

Pilot plant studies of nitrification-denitrification in activated sludge facilities treating domestic waste waters provided equations and printouts for design of nitrification and denitrification units. For nitrification tank design, a computer program and printouts were developed which present the equation in graphical form to facilitate use. The equation printouts provide minimum retention times necessary to achieve consistent nitrification. The oxygen requirement for full nitrification was 4 mg/l and the percent nitrification dropped with loading factors above 0.2 lb BOD5 per day per pound of mixed liquor suspended solids. In the denitrification unit the percent nitrate removal diminished with increasing dissolved oxygen supporting the theory that complete anaerobiosis is necessary for maximum denitrification. The rate of nitrate removal was directly dependent on the mixed liquor volatile suspended solids concentration of the denitrifying. The denitrification equation developed defines the minimum sludge concentration necessary for complete reduction of nitrates. While the constants in the equation solutions are gased on all weather conditions in the Pacific Northwest, a method for evaluating equation constants provides the means of applying the equation to any location.
W70-10118

EVALUATION OF PYRRONES AS MEMBRANES,
Franklin Inst. Research Labs., Philadelphia, Pa.
H. Scott, and F. L. Serafin.
Available from NTIS as NASA CR-1648, $3.00 in paper copy, $0.65 in microfiche. NASA CR-1648, September 1970. 35 p, 8 tab, 15 fig, 10 ref. NASA Contract NASl-8609.

Descriptors: *Membranes, *Waste water treatment, Membrane processes, *Reverse osmosis, *Osmosis, *Absorption, Plastics, Films, Desalination.
Identifiers: Polymidazopyrrolones, Pyrrones, Urine purification, *Polymers.

The facile absorption of water by polyimidazopyrrolones (Pyrrones) suggested a feasibility study to use films of the polymers as membranes for the purification of water by reverse osmosis. Direct osmosis measurements of water, salt, and urea fluxes through Pyrrone membranes are described. The data indicate comparable flux values and superior water-to-salt permeabilities of the Pyrrones relative to symmetric cellulose acetate membranes. Coupled with better mechanical strength and chemical resistance, these results suggest that the successful fabrication of asymmetric Pyrrone membranes could lead to substantial improvements over asymmetric cellulose acetate, from which the best reverse osmosis membranes are currently prepared.
W70-10125

ALGAL RECORDS FOR THREE INDIANA SEWAGE STABILIZATION PONDS,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
C. Mervin Palmer.
Proceedings of the Indiana Academy of Science, Vol 78, p 139-145, 1968. 3 tab, 8 ref.

Descriptors: *Sewage lagoons, *Algae, *Sewage treatment, *Indiana, Chlorophyta, Cyanophyta, Diatoms, Seasonal, Euglena, Chlamydomonas, Chlorella, Scenedesmus, Sampling, Oxydation lagoons.
Identifiers: Blue-green algae, Nitzschia, Biological studies, Algal identification.

Three sewage stabilization ponds in southeastern Indiana were among several throughout the United States selected for biological studies, with particular emphasis on the algal flora. Algal identifications have been recorded from 376 samples collected from the ponds during a period from May 1962 to August 1968. Although certain genera were found frequently in all three ponds, each pond had a distinctive algal flora. Green algae were invariably the most abundant; however, flagellates were also prominent. Of a total of 64 genera of the most significant and abundant algae there were 29 green algae, 19 flagellates, 10 blue-green algae, and 6 diatoms. Some genera were limited to the summer season, while others were most prominent in spring and fall or in winter. The pollution-tolerant algae, Euglena and Nitzschia, were abundant and persistent in all three ponds. The biochemical oxygen demand at the intakes was about 500 ppm and for the effluents less than 50 ppm. The first virus infecting a blue-green alga was isolated from one of the ponds in Ripley County. (Jones-Wisconsin)
W70-10173

FILTRATION OF ALGAL SUSPENSIONS,
Bohna Engineering and Research Inc., San Francisco, Calif.
I. J. Wright, and W. M. Luiz.
Bohna Engineering and Research, Incorporated, San Francisco, California, Bohna Internal Report F170, 1970. 31 p, 7 fig, 10 tab.

Descriptors: *Waste water treatment, *Filtration, *Algae, *Suspension, Harvesting, Ponds, California, Scenedesmus, Suspended load, Nitrates, Calcium carbonate, Proteins, Filters, Engineers estimates, Economics, Feasibility, Costs, Annual costs, Pilot plants.
Identifiers: Firebaugh (Calif), Volatile solids, Sanborn filter, Backwashing.

The Sanborn Filter, proprietary of Bohna Engineering and Research, Inc, a fabric and granular-media device, has been evaluated for use in harvesting algae from ponds of the Agricultural Waste Water Treatment Center at Firebaugh, California. Removals of up to 98% have been achieved without the use of flocculants or other chemical additives. The backwash from the filter has suspended solids concentrations up to 1.7% which shows evidence of increased coagulation, allowing the concentration of solids to a level of 8% to 12% by simple sedimentation. An economic analysis of the use of algae for nitrogen stripping of San Joaquin Valley drainage water was made. Assuming a flow sheet which includes lined, mixed growth ponds followed by filtration with the Sanborn Filter, concentration of the backwash by sedimentation or centrifugation and air drying of the algae, an approximate total cost of $37.01 per million gallons treated is projected, based on amortization and interest charges of 10% per year of the initial investment. Capacity of 700 million gallons per day was assumed. (Jones-Wisconsin)
W70-10174

WATER QUALITY BEGINS AT THE LOCAL LEVEL,.
American Chemical Society, Washington, D.C.

Environmental Science and Technology, p 281-282, Vol 4, No 4, April 1970. 2 fig.

Descriptors: *Treatment facilities, Industrial wastes, Hydrologic budget, Sewage treatment, Lake Erie, Waste water treatment.
Identifiers: *Cleveland, Cuyahoga River.

Since the adoption of a $100 million water bond issue in November 1968, Cleveland, Ohio has been modernizing existing sewage treatment plants and making plans for the expansion and renovation of its entire waste water treatment program. Cleveland's Clean Water Task Force, set up in January 1969, has directed its attention toward three crucial areas: updating the city's three treatment plants and designing a new treatment unit for one of the plants which will substitute physical-chemical treatment for biological treatment, designing a new sewage collection and transportation network, and encouraging joint industrial-municipal treatment schemes. (Holmes-Rutgers)
W70-10177

CONTROL OF THERMAL EFFECTS AT BEAVER VALLEY STATION,
Duquesne Light Co., Pittsburgh, Pa.; Worcester Polytechnic Inst., Mass; and Stone and Webster Engineering Corp., Boston, Mass.
Robert J. McAllister, Lawrence C. Neale, and Bruno Brodfeld.
Journal of the Power Division, Proceedings of ASCE, Vol 96, No PO3, Proc Paper 7319, June, 1970, p 287-298. 9 fig.

Descriptors: *Thermal pollution, *Cooling towers, Effluents, Jets, Mixing, Powerplants, Rivers, Temperature, Flumes, Froude number, Outlets, Waste dilution.
Identifiers: Entrainment.

By combining a once-through condenser water system with a supplemental cooling tower, the required temperature criteria can be met in the operation of Beaver Valley Station, even for the minimum discharge. On the average cooling tower assistance is necessary only two to three months each year, but not continuously. A feature of the site is the local configuration of Ohio River which branches into a main navigable channel and a smaller back channel, with the plant outlet located on the river. Field studies and model tests were carried out to investigate means for improving river flow distribution. The model comprised approximately a 2-mile reach of the river at a horizontal scale of 1:125 and a vertical scale of 1:25. It was found that the outlet orientation could be optimized to ensure maximum river flow entrainment into the back channel by the discharged jet. Analysis and tests results showed that warm water recirculation between discharge and intake structures would be adequately controlled by increasing effluent dilution in the back channel. Temperature patterns at the surface and in cross sections were determined on the model for a two mile long river beach. (Upadhyaya-Vanderbilt)
W70-10215

WASTE HEAT DISPOSAL FROM POWER GENERATING STATIONS,
Federal Power Commission, Washington, D.C.
F. S. Brown.
Journal of the Power Division, Proceedings of ASCE, Vol 96, No PO3, Proc Paper 7317, June, 1970, p 277-286.

Descriptors: *Thermal pollution, *Cooling water, Condensers, Cooling towers, Thermal powerplants, Water quality.
Identifiers: *Waste heat.

Steam-electric plants, nuclear or fossil fueled, are expected to provide the bulk of the growing needs for electric energy. As part of the operating cycle, such plants require large flows of water through the condensers to convert the exhaust steam to water. The condenser cooling water absorbs large amounts of waste heat which must be dissipated in some manner. The types of cooling systems in use include once through, cooling ponds, and cooling towers of either mechanical or natural draft design. Cooling towers are used where water supplies are limited or water quality standards prevent use of streams or lakes for waste heat disposal. Cooling towers add to power costs and are aesthetically undesirable. The addition of heat to water bodies may produce adverse effects on aquatic organisms. Although substantial studies have been completed or are under way, additional research is needed on the waste heat disposal problem. Areas of necessary research include the biological effects, the transport and behavior of heat in water, improved methods of cooling, and means of making beneficial use of waste heat. (Upadhyaya-Vanderbilt)
W70-10219

TECHNICAL NORMS FOR COMPUTATION OF COOLING PONDS (In Russian).

Gosudarstvennoe Energeticheskoye Izdatel'stvo, Moscow, 1963. 103 p, 13 fig.

Descriptors: *Cooling, Ponds, Temperature, Heat balance, Heated water, Evaporation, Convection, Energy transfer, Thermal stratification, Heating, Water cooling, *Thermal powerplants, *Thermal pollution, Radiation.
Identifiers: *Cooling ponds.

The norms presented here are determined for the practical design of cooling ponds serving steam-electric power plants. The cooling ponds are classified according to purpose, hydrological conditions, design parameters, and exploitation. As to hydraulic design the ponds can be divided into two groups: (a) ponds with a great degree of B/Bo ratio, (B-width of pond, Bo-width of intake), and (b) ponds with a small B/Bo degree. A critical ratio is B/Bo—6. The norms present a means of computation of active cooling surface area and active cooling specimen volume of the pond. The temperature computation uses the energy budget approach and presents all formulae necessary for temperature and temperature decay computations. An example of the computation of a cooling pond is solved and presented. (Novotny-Vanderbilt)
W70-10223

A REVIEW OF THE 1969 LITERATURE ON WASTE WATER AND WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 1.
W70-10267

ELECTROPHORETIC CLARIFICATION OF WATER,
Texas A and M Univ., College Station. Water Resources Inst.
E. A. Hiler, and W. M. Lyle.
Available from NTIS as PB-194 566, $3.00 in paper copy, $0.65 in microfiche. Texas A and M University, Water Resources Institute Technical Report No 31, August 1970. 127 p, 9 tab, 37 fig, 28 ref. 2 append. OWRR Project A-009-TEX (2).

Descriptors: *Water treatment, *Water purification, *Tertiary treatment, Pesticide removal, Filtration, Desalination, *Waste water treatment, *Electrophoresis, *Electrochemistry, Electrolysis, Physicochemical properties, Chemical reactions, Water chemistry, Analytical techniques.

The direct use of electric currents and electric fields to bring about water clarification and purification was investigated. Electrophoretic and electrochemical systems appear well adapted for removal of these electrically charged pollutants and in addition have the potential of being entirely automated. Numerous design concepts are advanced and tested through the use of laboratory models. These include a parallel plate model which was designed entirely for electrophoretic removal, and porous filter and electrode grid models which incorporated both electrophoretic and electrochemical capabilities. Successful water clarification was attained with the parallel plate model only when the influent water was of very low electrical conductivity. Electrolysis products at high conductivities caused sufficient turbulence to completely disrupt electrophoretic transport. In addition, primary and secondary chemical reactions took place due to electrolysis, which altered the characteristics of the suspension. It was also concluded that the ease of automation with an electrophoretic system does not justify the high cost of water treatment by this method. Water purification by electrochemical means overcame this problem and was successful both operationally and economically. As a result of the experimental testing, an example design of a small semiautomated electrochemical water system is offered which incorporates electrochemical flocculation, settling and electrochemical disinfection operations.
W70-10314

TASK I REPORT: SURVEY OF LARGE-SCALE HEAT REJECTION EQUIPMENT,
Dynatech R/D Co., Cambridge, Mass. Thermal Engineering Group.
For primary bibliographic entry see Field 05G.
W70-10315

AUTOMATIC WATER AND WASTE TREATMENT PLANTS IN OPERATION,
Stone (Ralph) and Co., Inc., Los Angeles, Calif.
Ralph Stone, and E. T. Conrad.
Civil Engineering, American Society of Civil Engineers, Vol 40, No 5, p 37-40, May 1970. 4 fig, 2 tab.

Descriptors: *Sewage treatment, *Water treatment, *Activated sludge, Filtration, Chlorination, Oxidation, Aeration, Cost, Waste water treatment, California.
Identifiers: *Napa-Berryessa Improvement District, *Automatic control, Clarification.

Water and waste treatment for the Napa-Berryessa Improvement District and Lake Berryessa in California depend on an automatic system. The water facilities are an intake structure; treatment plant which provides for taste, odor, and pH control clarification, filtration and chlorination; pump station; 7,000 ft transmission main; storage tank; and distribution system. The entire water system is controlled automatically using water levels at various points to start and stop the intake and booster pump stations. The intake pumps are mounted on a carrier and move up and down with the lake level. The system was designed for peak flows of 0.5 mgd, expandable to 1.0 mgd and ultimately to 4.0 mgd. The sewage facility treats a load of 0.175 mgd with easy expansion to 0.35 mgd incorporating an activated sludge plant followed by oxidation basins. Two booster pumps, controlled automatically by the level in the oxidation basin, pump the effluent to the disposal area. The treated waste is disposed through hillside irrigation employing 80 acres with natural slopes up to 1:1. The land was divided into four subdivisions, three sections intermittently irrigated by automatically controlled 50,000 gal storage tank, and the fourth section allowed to fully dry between dosings. Drainage ditches and a collection pond prevent contamination of lake waters. The total construction cost was $735,644 with $32,324 going for the automatic control system. (Sorber-Texas)
W70-10328

WATER REUSE AND RECYCLING IN INDUSTRY,
Engineering-Science, Inc., Austin, Tex.
J. Eller, D. L. Ford, and E. F. Gloyna.
Journal of the American Water Works Association, Vol 62, No 3, p 149-154, March 1970. 5 fig, 3 tab, 19 ref.

Descriptors: *Industrial water, *Water reuse, *Economics, Municipal waste water, *Cost analysis industries, Tertiary treatment, Pollutants, Waste water treatment.
Identifiers: *Water recycle.

The current status of industrial water reuse and recycling was surveyed by a presentation of representative case studies. In the majority of cases involving industrial reuse it is necessary to provide some form of treatment and several industries are using several forms of tertiary treatment in support of water reuse and recycle practices. Particular emphasis is placed on reuse of municipal waste waters by selected industries. An economic balance equation on water reuse was discussed and a simplified model establishing a basis for making economic decisions presented. (Waid-Texas)
W70-10329

TERTIARY TREATMENT OF WASTE WATER,
Michigan State Univ., East Lansing. Div. of Engineering Research.
K. L. Schulze.
Developments in Industrial Microbiology, Vol 9, p 175-185, 1968. 6 fig, 2 tab, 21 ref.

Descriptors: *Phosphates, *Waste water, *Waste water treatment, *Tertiary treatment, Coagulation, Electrodialysis, Reverse osmosis, Protozoa, Rotifers, Annelids, Activated carbon, Adsorption.
Identifiers: *Lake Tahoe Public Utility District, *Santee Valley, *Lebanon, Ohio, Epiphyton.

Using data obtained from continuous flow culture of bacteria, it was demonstrated that secondary waste water treatment processes are inherently incapable of attaining high grade removal of nutrients, especially nitrogen and phosphorus compounds. Activated sludge plants have maximum removal capability of 49% for nitrogen and 33% for

phosphate related to primary effluent. This necessitates the development of tertiary treatment. A survey of the physico-chemical and biological tertiary treatment methods and their results were presented. Special emphasis was placed on an attempt to assess the possibility of large scale nutrient removal by biological means. Pilot plants at Lebanon, Ohio and full scale operations at Santee Valley and Lake Tahoe Public Utility District plants in California were described. It is suggested that combination of a tertiary treatment slip with irrigation for crop production be used as a possible solution. It is urged that industry substitute another detergent filler for phosphates. (Waid-Texas)
W70-10331

THE CROSSNESS SEWAGE TREATMENT WORKS, GREATER LONDON COUNCIL: FIVE YEARS OPERATION 1963-68,
R. W. Horner, J. V. Stedman, F. G. Stark, and R. Davis.
Water Pollution Control, Vol 69, No 2, p 180-194, March-April 1970. 4 fig, 7 tab, 3 ref.

Descriptors: *Activated sludge, *History, *Sewage treatment, *Settling basin, *Screens, Sludge treatment, *Disposal, Performance, Biochemical oxygen demand, Waste water treatment.
Identifiers: *Extension, Detritus channels, London (England).

The operation and the basic design of sewage treatment works at Crossness, London are discussed. The new works was designed to handle a flow of 100 mgd in dry weather and a maximum flow of 216 mgd. The activated sludge plant is designed to treat a flow of 72 mgd to a 30:20 standard. Considering the heavy loading during storms, the performance of the six low level and four high level screens have been satisfactory. The grit removed from the detritus channels averages 121 cu yd/week. An improvement in the quality of the settled sewage coincides with the improved performance of the activated sludge plant. Primary sedimentation tanks are now capable of producing 120 mg/l SS when treating the dry weather flow. Performance of the activated sludge plant during the first and second year of operation is described. During the second year the treatment exceeded the design flow and difficulties were encountered due to overloading. The performances of primary and secondary sludge digestion are also presented. In general, the plant has operated well despite minor difficulties. (Shankar-Texas)
W70-10332

CITY OF OXFORD: EXTENSION TO SEWAGE-TREATMENT WORKS,
Oxford (England).
A. T. Morris, C. E. Copeland, and V. H. Lewin.
Water Pollution Control, Vol 69, No 3, May-June 1970, p 249-268. 7 fig, 5 ref.

Descriptors: *Sewage treatment, *Design, Effluent, Tertiary treatment, Biochemical oxygen demand, Sludge, Digestion, Organic loading, Dissolved oxygen, Sampling, Waste water treatment.
Identifiers: *Extension, *Clarifloculator tanks, *Storm sewage, Suspended solids, Flood lighting, Blower house, Magnetic flow meters, Automatic sampler, Oxford (England).

The sewage treatment works in the city of Oxford was originally designed to treat 5 mgd dry weather flow (dwf) from a population of 110,000 and to produce an effluent complying with a 30:20 standard. The extension has been designed for a dwf of 10 mgd from a population of 132,000 using an equivalent water consumption of 75 gal/hd d. The activated sludge process continued to be the best method, but to improve flexibility, and production of high quality effluent, additional parallel lanes of treatment were considered to be essential. Provisions for dealing with storm sewage was anticipated for this section of the extension. Other new features are rapid gravity sand filtration, rectangular secondary sludge digestion tanks and facilities for the separate consoldiation of surplus activated sludge. A sketch of the new primary and storm-sewage/balancing tanks, activated sludge plant the new final separating tanks are presented. Ram pumps deliver the sludge to the existing elutriation tanks after which it is pumped to the vaccum filtration plant for dewatering. Liquid sludge is distributed to farm land as a soil conditioner. Sewage flows and final effluent are measured by standing-wave flumes. (Shankar-Texas)
W70-10333

TANK CLEANING STATIONS FOR TANKERS,
Societe des Eaux de Marseille (France).
G. Bossy.
Fifth International Water Pollution Research Conference, San Frncisco, July 26-August 1, 1970. Preprint, Paper III-14, 6 p, July-August 1970. 2 tab, 2 ref.

Descriptors: *Water pollution control, *Oils, *Waste disposal, *Stations, Waste water treatment, Oil wastes, Cost.
Identifiers: *Tanks, *Oil tankers, Rinsing.

Ocean pollution by hydrocarbons results mainly from (1) accidental causes: due to errors in manoeuvering, collisions, grounding, acts of war, fracture of pipe lines, and (2) systematic causes: on which action is possible, i.e., draining the holds of cargo vessels, trawlers, liners, lubricant oil, draining on vessels, rinsing and unloading ballast water from tankers. After vessels unload, there actually remains 0.4% of the load in the tanker, formed by residues sticking to the tank walls. For many years, these residues, which tankers must get rid of for reasons of maintenance and security, have been evacuated into the sea by the use of rinsing water. The quality of residues ejected on all seas, and particularly into the Mediterranean Sea and the Atlantic Ocean, may be estimated at some 3 million tons a year. A tank cleaning station should be situated in a region of intense pretrochemical activity and in a tanker repair port. An example is the Marseilles station which is located in the port installations. It has a 90 m long quay with a draught of 10 m where tankers of up to 100,000 tons can be moored. An area of some 25,000 sq meters is available, with a treatment capacity of 12000 t/h. The station offers facilities for cleaning and degasifying tankers, coasters, tank wagons and trucks. The residues, slop, rinsing water, are separated. The hydrocarbon mixture receives treatment to raise its flashpoint. The station is equipped with a permanent separator tank, 2 reception tanks, 1 tank for treatment, 1 extractor, and storage tanks. (Hancuff-Texas)
W70-10334

A MATHEMATICAL MODEL FOR THE WET-AIR OXIDATION OF SLUDGE,
Kyoto Univ. (Japan). Faculty of Engineering.
T. Takamatsu, I. Hashimoto, and S. Sioya.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-32, 8 p, July-August 1970. 7 fig, 1 tab, 5 ref.

Descriptors: *Mathematical models, *Oxidation, *Sludge, *Sludge treatment, Chemical oxygen demand, Sewage treatment, Waste water treatment.
Identifiers: Decomposition.

It has been discovered that the wet-air oxidation of sludge is composed of two phenomena, that is, sludge decomposition without oxygen followed by the oxidation of the decomposed sludge by oxygen, at a temperature of 170 - 250 deg C and a pressure of 60 - 130 kg/sq cm-gauge. A mathematical model of this reaction process is proposed in terms of COD and weight of solid matter, soluble nonevaporative matter and soluble evaporative matter in sludge. The parameters involved in the mathematical model are estimated by a nonlinear estimation technique. Sludge is a highly complex mixture and the complexity of its composition makes it difficult to represent its thermal decomposition and oxidation in a mathematical form. As the mathematical model should be as simple as possible, the sludge content is roughly classified into four categories. They are: (1) solid matter, (2) soluble nonevaporative matter below 120 deg C, (3) soluble evaporative matter above 120 deg C, (4) pure water. Separate mathematical models are derived for the (1) thermal decomposition process, (2) relation between thermal decomposition and oxidation, (3) oxidation process. Experiments carried out by using artificially cultured activated sludge have verified that the model is applicable for the reaction of sewage sludge. Thus, it will become possible to control and design the wet-air oxidation process on a quantitative basis by using the mathematical model proposed here. (Hancuff-Texas)
W70-10335

BIOLOGICAL TREATMENT OF THERMALLY CONDITIONED SLUDGE LIQUORS,
Zimpro, Inc., Rothschild, Wis.
A. H. Erickson, and P. V. Knopp.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-33, 15 p, July-August 1970. 7 fig, 6 tab, 31 ref.

Descriptors: *Filtration, *Biological treatment, *Sludge, *Sludge treatment, Oxidation, Chemical oxygen demand, Mathematical models, Kinetic, Nitrification, Nitrogen, Efficiency, Performance.
Identifiers: Oxygen transfer, Mass balance.

Described are the results of biotreatment of thermally conditioned sludge liquors in their undiluted form with the purpose of: (1) defining the fraction of organic carbon (as CO COD) which is non-biodegradable. (2) determining yield and endogenous decay coefficient, (3) developing parameters for use in full scale design and cost estimating. The liquor for the biotreatments was prepared by processing approximately 2,000 gallons of mixed primary and waste activated sludge from the Stevens Point, Wisconsin sewage treatment plant (primary and activated sludge) through a 5 gallon per minute pilot plant thermal conditioning system. Two types of feed material were used representing two levels of thermal conditioning vis. 5-10% oxidation or low oxidation and 70% wet air oxidation or highoxidation. The feed COD concentration ranged from 7,000 to 12,200 mg/l BOD, nitrogen, phosphorus and pH showed similar variation. BOD5 removals in excess of 90% were accomplished at loading rates as high as 4.0 pounds BOD applied per pound of mixed liquor volatile suspended solids. The sludge solids yielded sludge volume indices in the range of 60-80mg/l suspended solids. Oxygen transfer rates were determined and for the system KL was correlated with superficial air velocity. Undiluted liquors will support growth of nitrifying organisms under loading conditions normally assumed to be required for nitrification oin activated sludge systems, i.e. loading rate less than .32 pounds BOD per pound MLVSS. (Hancuff-Texas)
W70-10336

THE EFFECT ON THE CHEMICAL CONTENT OF SEA WATER WITH A LIMITED EXCHANGE OF WATER FROM A LARGE OCEAN OF POLLUTING DISCHARGES OF CHEMICALS (WITH THE BALTIC SEA AS AN EXAMPLE),
Akademiya Nauk SSSR. Institut Okeanologii.
A. Simonov, and A. Justchak.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper III-12, 3 p, July-August 1970.

Descriptors: *Marine microorganisms, *Marine plants, *Oceans, *Chemical wastes, *Water pollution control, Discharge (Waters), Oils, Ammonia, Biochemical oxygen demand, Phosphorus, Waste water disposal, Industrial wastes.
Identifiers: *Baltic Sea.

The problem of preventing sea water pollution by industrial and domestic discharges is one of con-

siderable importance, since progressive pollution of sea water can result in a sharp deterioration of sanitary conditions and may cause considerable damage to the fishing industry. Discharges of pollutants are particularly dangerous when the receiving waters have low flushing characteristics due to their limited exchange capacity with the major adjacent ocean. The Baltic Sea is a typical example of this case. To date, the systematic investigation into the chemical pollution of the Baltic Sea has been quite limited. Because of this lack of information the Hydrological Service of the USSR decided to make a systematic study of the chemical composition of the waters in the Baltic Sea coastal areas. The data from these investigations includes the following: oil products, phenol, ammonia, organic substances, oxidizability, Biological Oxygen Consumption (BOC5), oxidic medium reaction, oxygen and biogenic substances. Under the influence of domestic and industrial discharges the following conclusions may be drawn: (1) the natural composition of sea water has changed over a period of years, this is reflected by the increase in ammonia, organic phosphorus and oxidizability levels, (2) oxygen deficiency in many coastal waters has been observed. (Hancuff-Texas)
W70-10337

TREATMENT OF PULP MILL EFFLUENTS ON SORPTION RESINS,
D. Ruzickova.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-34, 9 p, July-August 1970. 5 fig, 4 tab, 7 ref.

Descriptors: *Pulp and paper industry, *Effluent, *Sorption, Industrial wastes, Resins, Ion exchange, Testing, Sulfite liquors, Waste water treatment, Efficiency, Equilibrium.

The object of this study was to show the possibility of treating some types of pulp mill effluents by reversible sorption on sorption resins. The idea of utilizing the properties of sorption resins for the treatment of waste waters, polluted with organic, especially biochemically resistant substances, arose from findings in water treatment by demineralization. Anion exchange resins after long use inactivated by the irreversible linkage of some types of high-molecular organic compounds are only partially liberated during recovery. This fact is attributed to the low diffusion velocity of their voluminous organic molecules. For this reason one sometimes precedes ion exchange filters in demineralization plants with suitable sorption resin media, which permit efficient sorption and especially desorption of the high-molecular organic compounds. On the basis of preliminary tests conducted under static and dynamic conditions, it has been found that for the removal of organic pollution from pulp mill effluents (from the production of sulphite pulp) a suitable type is the resin OSTION-SL (L-33). The treatment removes colour-producing and biochemically resistant substances which is of importance for the reuse of treated water in the production process. This resin can be also used for sulphate pulp mill effluents treatment after biological pretreatment as in the case of sulphate pulp mill effluents and bleaching process effluents. (Hancuff-Texas)
W70-10338

SIGNIFICANCE AND LIMITS OF THE BUCHNER-FUNNEL-FILTRATION-TEST (BFFT),
E. Zingler.
Fifth International Conference on Water Pollution Research, San Francisco, July 26-August 1, 1970. Preprint, Paper II-31, 8 p, July-August 1970. 5 fig, 6 ref.

Descriptors: *Filter, *Vacuum drying, *Test procedure, *Limiting factor, *Laboratory tests, Evaluation, Sludge, Sludge treatment, Waste water treatment.
Identifiers: *Buchner funnel, Vacuum filtration.

Assessments of properties and filterability of sewage sludges are gained through laboratory tests. However, it is well known that there is a risk when the lab. testing results are practically applied. This risk must be attributed to: (a) a lack of standard methods, (b) insufficient attention given to factors of technical procedure. In an account of a research project on sludge dewatering the results of Buchner-Funnel-Filtration-Tests (BFFT) are presented for subpressure conditions. Exemplified by the Buchner-Funnel some causes must be pointed out which may lead to divergencies in the results arrived at by various researchers: (a) Considerable divergencies emerge if different filterpapers are used in filtering untreated sludges. (b) So far no attention has been given to the storage capacity of the perforated plates of the Buchner-Funnels. Depending on construction and diameter 2 to 14 cu cm of sludge water are retained in the slotted plates before the filtrate flows into the measuring cylinder. (c) The quality of comparable parameters is decisively codetermined by test arrangement and implementation. (d) A further instability factor for comparable parameters results from the recommendation to build up slowly the required pressure. (Hancuff-Texas)
W70-10339

QUALITY PREDICTIONS IN A POLLUTED ESTUARY,
Clyde River Purification Board, Glasgow (Scotland).
D. W. Mackay, and J. I. Waddington.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper III-7, 6 p, July-August 1970. 4 fig, 4 ref.

Descriptors: *Estuaries, *Water pollution control, *Water quality, Retention, *Sewage disposal, Sewage treatment, Dissolved oxygen, Flows, Tides, Rivers.
Identifiers: Marine disposal.

Methods of measuring the degree of organic pollution in an estuary and predicting the effects of changes in the polluting load are described. A reduction in the load from one source produced a considerable improvement along the length of estuary considered, the extent of which was in accordance with that predicted. A relatively simple approach to the problem of estuary management has produced results useful for dealing with such problems as (1) the acceptability of new polluting discharges, (2) the priorities to be established from improvement of existing discharges, (3) predicting the effects of large scale water abstraction from one of the main feeder rivers and (4) predicting the temperature rises which might be expected from the siting of thermal power stations at various locations. No claim is made that a full understanding of the processes involved has been achieved, for example current work is showing that the relationship between dissolved oxygen and freshwater flow derived during a period of normal rainfall pattern does not hold good under conditions of exceptionally prolonged drought. As the investigation continues with more refined techniques, it should be possible to discard initial assumptions and render this useful and relatively economic approach adequate for the task of aiding the management of a rapidly changing estuary system. (Hancuff-Texas)
W70-10340

STUDIES ON PARAMETERS AFFECTING SLUDGE DEWATERING IN PRESSURE FILTERS,
Emschergenossenschaft, Essen (West Germany).
H. Graefen, and H. J. Donges.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-30, 10 p, July-August 1970. 12 fig, 5 ref.

Descriptors: *Dewatering, *Filters, *Sludge, Pressure, *Sludge treatment, Sewage treatment, Filtration, Design, Efficiencies, Fly ash, Activated sludge, Waste water treatment.
Identifiers: Pressure filters, Filterability.

Pressure filters are more and more used for the dewatering of waste water sludges. In general they enable dewatering to a degree such as to obtain firm and transportable sludge cakes with solid contents of more than 50%. At the same time, the sludge volume is reduced to less than 20% of the initial sludge volume. Due to the high degree of dewatering, the caloric value of these sludge cakes is usually above 1500 kcal/kg so that they will burn on their own without additional fuel. The properties of the sludge, especially its filtrability, form the decisive parameter for the efficiency of the pressure filters. To characterize the properties of the sludge, parameters such as the solids content, the structure and the size distribution of the solids, the index of the activated sludge and the organic matter are generally used. These and possibly other characteristics can sufficiently describe various chemical and physical properties of the sludge. In general, domestic and industrial sewage sludges cannot be dewatered in pressure filters without previous conditioning. This applies especially to activated sludge. Improvements of the filtrability of sludges can be attained by filter aids such as iron chloride, iron sulphate and lime, or by the addition of polymers or solid matter, especially fly ash. Much more effective for improving the filtrability of activated sludge is thermal conditioning. (Hancuff-Texas)
W70-10341

VIRUS REMOVAL BY ADSORPTION IN WASTE WATER TREATMENT PROCESSES,
Maine Univ., Orono. Dept. of Civil Engineering.
Otis J. Sproul, Murray Warner, Leo R. La Rocholle, and Dirk R. Brunner.
Fourth International Conference on Water Pollution Research, Prague, Czech., September 2-6, 1968. Preprint, Paper 13, 7 p.

Descriptors: *Viruses, *Activated carbon, *Adsorption, *Efficiencies, *Phosphates, *Chemical precipitation.
Identifiers: *Virus removal.

Studies on the removal of viruses from waste water by activated carbon adsorption and calcium and aluminum phosphate precipitation are described. Viruses employed in this work were the T2 bacteriophage and Type 1 poliovirus (Sabin). They were suspended in domestic secondary treatment plant (trickling filter and activated sludge) effluent or saline water for all runs. Virus removal by activated carbon adsorption with an initial T2 virus concentration of 1,000,000 plaque forming units (Pfu) per ml resulted in maximum removals of 32, 9, and 7 percent at column hydraulic loadings of 40.8, 122, and 326 l/min/sq m, respectively. It was observed during the poliovirus runs that after 25 l input, virus concentrations in the effluent exceeded those of the influent to the columns indicating a reversible process. Precipitation by calcium phosphate resulted in poliovirus removals exceeding 90%, for an initial phosphate concentration of 85 mg/l and 182 mg/l calcium hydroxide. T2 removals by aluminum phosphate precipitation exceeded 98% and reached 99.9% for various initial phosphate concentrations and alum dosages. It was concluded that virus removal by activated carbon adsorption is not a dependable process but that removals by phosphate precipitation would appear both reliable and a valuable additional benefit in the removal of phosphate. (Sorber-Texas)
W70-10342

PRESSURE FILTRATION OF SECONDARY TREATMENT PLANT EFFLUENT,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Edward L. Berg, and Carl A. Brunner.
Water and Wastes Engineering, Vol 6, No 10, p 54-58, October 1969. 5 fig, 6 tab.

Descriptors: *Effluents, *Pilot plants, *Filtration, *Costs, *Waste water treatment, *Tertiary treatment, Flocculation, Operating costs.

Identifiers: *Single medium filtration, *Dual media filtration, Anthracite coal, Polyelectrolytes, Alum.

A field study using a commercial pressure filter to clarify secondary treatment plant effluent is described. Two different filter beds were evaluated: a single-medium filter consisting of 20 inches anthracite coal (effective size 0.75 mm) and a dual-media filter consisting of 6 inches sand (effective size 0.45 mm) and 14 inches anthracite coal. Filtration rates were either 5 or 10 gpm/sq ft and filter performance was determined by measurement of filter headloss, influent suspended solids and effluent turbidity. Four different polyelectrolytes were investigated in conjunction with varied alum dosages. Results indicated that cationic polyelectrolytes were more effective in preventing floc break through than were the nonionic or anionic polyelectrolytes. For the single medium filter using dosages of 2.16 mg/l polyelectrolytes and 14.5 mg/l alum at a filtration rate of 10 gpm/sq ft. total organic carbon (TOC) removal was 50% and phosphate removal was 17%. Slightly better TOC removal and significantly less phosphorus removal was observed in the dual media filter under similar conditions. Estimates for a 1 mgd capacity plant indicated a total cost of 6.7 cents per 1000 gallons for this type treatment. (Sorber-Texas)
W70-10343

PILOT PLANT STUDIES OF EFFLUENT RECLAMATION,
Eimco Corp., Salt Lake City, Utah.
J. D. Phillips, and G. L. Shell.
Water and Wastes Engineering, Vol 6, No 11, p 38-41, November 1969. 4 fig, 5 tab, 7 ref.

Descriptors: *Effluent, *Reclamation, *Pilot plants, *Filtration, Coagulation, Activated carbon, Phosphorus, Biochemical oxygen demand, Alkylbenzene sulfonates, Irrigation water, Cooling water, Water reuse.
Identifiers: *Dual-media filtration, Chemical treatment, Suspended solids.

A two-phase study to determine the best processes to be used for reclaiming sewage treatment plant effluent for use as irrigation water and inexpensive cooling tower make-up water is discussed. The first phase dealt with the removal of larger suspended solids to prevent fouling of irrigation sprinklers. A dual-media filter employing anthracite coal and sand was investigated. It was found that an 8 foot deep filter consisting of 50% anthracite was most effective in removing the suspended solids. Results indicated that filter runs of up to 50 hours could be achieved at filtration rates of between 10 and 20 gpm/sq ft. Suspended solids removal varied between 24 and 35%. The second phase involved producing a good quality effluent to be used as cooling tower make—UP WATER. Processes selected were chemical coagulation, dual-media filtration, and activated carbon adsorption. Coagulation with lime at 325 mg/l or alum at 175 mg/l resulted in 74-85% removal of BOD5; 70-80% removal of suspended solids; and 91-95% removal phosphorus. A 50% anthricite 4-ft-deep dual media filter produced further reductions in BOD5, suspended solids and phosphorus of 25%, 60%, and 50%, respectively. Carbon adsorption results in indicated additional removals of 33% for BOD5; 80% for COD; 25% for suspended solids; 50% for phosphorus; and 97% for ABS. (Sorber-Texas)
W70-10344

NUCLEIC ACID AS A COMPONENT OF MUCILAGE IN ACTIVATED SLUDGE,
Kurita Central Labs., Yokohama (Japan).
Shozo Nishikawa, and Mitsuo Kuriyama.
Water Research, Vol 2, No 7, p 811-812, July 1968. 2 tab, 5 ref.

Descriptors: *Activated sludge, *Biochemistry, *Enzymes, Metals.
Identifiers: *Nucleic acid, *Deoxyribonuclic acid (DNA), *Ribonucleic acid (RNA), Composition.

It is reported that high amounts of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) are contained in mucliage in activated sludge from sewage. The DNA and RNA are folded in the sludge floc and are protected with metal ions. The method of extraction of this DNA and RNA employs EDTA and 95% ethanol with sodium chloride. Fractionation and quantification followed for DNA and RNA of activated sludge and Escherichia coli. From E. coli only 1.8 percent of its RNA and a trace of DNA was extracted while as much as 40 percent of the DNA and RNA in the activated sludge was obtained. It was concluded that from activated sludge, (1) mucliage containing nucleic acid can be obtained without breaking down the living cells by extracting it with EDTA solution; (2) polymerized nucleic acid is folded in the floc as an insoluble form together with protein; (3) this nucleic acid is protected by metal ions; and (4) nucleo-protein released by autolyzis from microbial cells in the activated sludge is accumulated and is prevented from enyzmatic depolymerization. (Sorber-Texas)
W70-10345

THE DALLAS PHILOSOPHY-AN APPROACH TO WASTE WATER RECLAMATION,
Dallas, Tex.
Henry T. Graeser.
Water and Wastes Engineering, Vol 6, No 9, p 58-61, September 1969.

Descriptors: *Water reuse, *Research facilities, Water quality, Pilot plants, Political aspects, Public health.
Identifiers: *Water hygiene.

The problems, advances and necessity of increased waste water reuse are explored from a philosophical point of view. It is pointed out that waste water reuse is an actuality in many instances today and water requirements for the future make this practice of continuing increasing importance. Figures are quoted indicating that federal funds allocated for research in water hygiene in fiscal year amount to a mere 1 percent of the total for environmental pollution research. An example of what Dallas, Texas is doing or is planning to do at its water Reclamation Research Center and Laboratory is presented. Some of the problems of water reuse including public acceptance, costs, research, and interagency cooperation are explored. (Sorber-Texas)
W70-10346

WASTE WATER TREATMENT: THE TIDE IS TURNING,
Robert W. Holcomb.
Science, Vol 169, No 3944, p 457-459, 31 July 1970.

Descriptors: *Waste water treatment, Pollution abatement, Water pollution control, Sewage treatment, Tertiary treatment, Chemical precipitation, Activated carbon, Electrodialysis, Reverse osmosis, Filtration.
Identifiers: Microscreens.

A general discussion of the current state of sewerage and sewage treatment is presented. Successes in pollution abatement and properties of sewage are mentioned. Primary and secondary sewage treatment systems are described and performance data in terms of solids and Biochemical Oxygen Demand removal are given. New processes and systems of waste treatment are discussed with respect to BOD, solids, nitrogen and phosphorous removal. Comparisons are made between the performance and costs of new and old systems and processes. Specific developments and processes discussed are: the use of pure oxygen in the activated sludge process, the precipitation of phosphate with lime, multimedia filtration, microscreening, carbon adsorption of refractory organic compounds, ion-exchange units, electrodialysis, reverse osmosis. The problem of final sludge disposal is mentioned along with current solutions and desirable developments of the future. The need for a broad-based research and development program to solve existing problems and to explore new areas is elucidated. (Hewett-Rutgers)
W70-10350

SOME ECONOMIC ASPECTS OF WATER REUSE IN CZECHOSLOVAKIA,
International Water Pollution Research Conference (5th).
V. Reinhardt.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-31. 6 p, 2 tab, 12 ref.

Descriptors: *Water utilization, *Water re-use, Recirculated water, Reclaimed water, Water demand.
Identifiers: Effluent charges, Czechoslovakia.

Water re-use is a significant factor in water utilization. For water re-use via water courses, the relation between the treatment costs of discharged waste waters and damage caused by the polluted water is discussed. Statistical data are given showing a relatively high degree of recirculation of water in Czechoslovakian industry. Degree of circulation is a general index of level of water management, but is not a goal per se as there are other important factors to consider. Data are also given showing water use, and unit costs including some data on taxes for releasing untreated waste and municipal sewage charges. Industry has not yet used sewage effluent in Czechoslovakia, but the author outlines situations in which this would be very desirable. (Whipple-Rutgers)
W70-10372

THE APPLICATION OF A LINEAR PROGRAMME MODEL TO WATER CONSERVATION AND EFFLUENT MANAGEMENT AT MODDERFONTEIN FACTORY,
African Explosives and Chemical Industries Ltd., Johannesburg (South Africa); and National Inst. for Water Research, Pretoria (South Africa).
N. A. Lever, A. T. Alexander, R. J. Buttery, B. Moffat, and M. R. Henzen.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-30. 9 p, 2 fig, 3 ref.

Descriptors: *Linear programme, *Water conservation, Management, *Effluents, *Industrial wastes, *Mathematical models, Water supply, Water reuse, Constraints, Stochastic processes, Costs.

The demand for water in South Africa is briefly reviewed together with the need to purify effluents. Modderfontein Factory faces the problem of conserving water while at the same time satisfying tentative standards laid down by the Department of Water Affairs. There are a number of sources of second grade water available which could be used to supplement the limited supply of first grade potable water. A mathematical model is described which enables the effect of the use of various grades of water to be rapidly assessed, using the Company's IBM computer. The programme is run through weekly and the use of an optimum mix has enabled the factory to save 85 million imperial gallons per year of potable water giving rise to a new savings of R12,000 per year. It is concluded that mathematical modeling has wide application under similar conditions. (Hancuff-Texas)
W70-10374

THERMONALYTICAL CONTROL OF THE SLUDGE STABILIZATION PHENOMENA,
Research Inst. for Water Resources Development, Budapest (Hungary).
P. Benedek, P. Farkas, and P. Litherathy.
Fifth International Water Pollution Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper HA-8. 7 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Sludge, *Stabilization, *Digestion, Operations, *Design control, Anaerobic digestion, Biological treatment, Waste water treatment, Sewage treatment, Water pollution control.
Identifiers: *Thermoanalytic method.

The purpose of sludge stabilization is to decrease organic material subject to decomposition, as well as fixed or stored water in different forms, or rather to release the latter with a view to facilitation dewatering. Variation of organic material contents could be followed by measuring volatile solids. However, the former comprises both the weight loss due to Thermal decomposition of inorganics and the effect of evaporation of fixed water in the sludge. Presented is a reliable method for the practicing engineer with which he may follow variations of organic material and fixed water contents of sludge for the design operation and control of biological sludge stabilization systems. The extent of stabilization may be determined reliably with the ignition loss measurement applied in routine laboratories with the modification that first the ignition should be carried out in nitrogen and then the previously obtained carbon residue is ignited in oxygen. The sludge stabilization may be considered to be terminated when with increasing stabilization time the carbon determined by means of the above procedure does not further decrease. (Hancuff-Texas)
W70-10375

AN INTEGRATED BIOLOGICAL-CHEMICAL PROCESS FOR MUNICIPAL WASTE WATER TREATMENT,
California Univ., Berkeley. Sanitary Engineering Research Lab.
M. J. Humenick, and W. J. Kaufman.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-19. 18 p, 4 fig, 6 tab, 24 ref.

Descriptors: *Waste water treatment, *Biological treatment, Chemical precipitation, *Performance, Sewage treatment, Kinetics, Aeration, Activated sludge, Mathematical models, Efficiency, Phosphorus.
Identifiers: *Chemical treatment.

An integrated biological-chemical waste water treatment pilot plant was operated over a period of 8 months at organic loadings appreciably exceeding those normally employed in municipal biological waste treatment systems. The system involved two stages: biological stage followed by a precipitation flocculation stage with inorganic chemical solids recycled to the first stage to achieve continuous control over the separability of the biologically active solids. The results of the investigation are as follows: (1) removals of BOD were at an excess of 90% and COD an excess of 80%, at BOD loadings of 400 to 500 lbs per day per 1000 cubic foot variation. Under these conditions the residence time of the aeration basin may be reduced one hour and good performance may be expected with as little as 20 minutes of variation. Sludge volume indicies of over 100 were achieved at suspended solids concentration in exceeding 9,000 mg/l. Phosphorus removal of at least 95% was demonstrated with both lime and alum additions to the second stages of precipitation flocculation unit. The second stage clarifier was operated as a sluged blanket unit with the overall suspended solids removal generally exceeding 95%. The effluent was generally lower than 20 JTU and less than 10 for extended periods. (Hancuff-Texas)
W70-10376

TECHNIQUE OF EVALUATION OF SYSTEM PARAMETERS RELATING SOLIDS ACCUMULATION IN OXIDATION DITCHES PROCESS,
N. Chandhuri.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-10. 7 p, 5 fig, 3 tab, 13 ref.

Descriptors: *Evaluation, Performance, Kinetics, Mathematical models, Sludge, Waste water treatment, *Sewage treatment, *Biological treatment.
Identifiers: *Oxidation ditch, Solids wasting, Solids accumulation, Suspended solids.

Biologically, the oxidation ditch process is an extended sludge aeration modification of the activated sludge process. Like extended sludge aeration plants, oxidation ditches are without controlled sludge wasting, because it was believed that daily accumulation of sludge solids in the system would be negligible as the period of aeration was extended. Subsequent investigations disproved this belief and demonstrated that non-degradable fractions of microbial mass accumulated in the system. For better operational control of extended aeration plants a method should be evolved to predict accumulation of sludge solids. The paper presents a technique to evaluate system parameters relating to solids accumulation. A study was conducted on an oxidation ditch as a reactor vessel which was operated as a batch feed system using slow feeding a full days loading of nutritionally balanced glucose solution as a substrate. The oxidation ditch was operated at a wide range of volumetric process loadings of 20 to 100 lbs of COD per day per thousand cubic feet ditch volume. The system operated under conditions of no solids wasting showed an accumulation of sludge solids in amount equal to 18% by weight of the COD utilized. (Hancuff-Texas)
W70-10377

NITROGEN-PHOSPHATE RELATIONSHIPS AND REMOVALS OBTAINED BY TREATMENT PROCESSES AT THE HYPERION TREATMENT PLANT,
California State Dept. of Public Works, Los Angeles.
R. D. Bargman, J. M. Betz, and W. F. Garber.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-14. 17 p, 7 fig, 5 tab, 13 ref.

Descriptors: *Nitrogen, *Phosphorus, *Sewage treatment, *Nitrification, *Chemical precipitation, Nutrients, Waste water treatment, Efficiencies, Operations, Metals.
Identifiers: *Hyperion.

The Hyperion treatment plant of the City of Los Angeles received an average waste water flow of 340 MGD during 1969. In this daily flow were approximately 86,000 lbs of phosphate, 51,000 lbs of ammonia, and 102,000 lbs of organic nitrogen. Because phosphate removal as well as overall affluent quality requirements are becoming more severe, the secondary treatment design parameters may well have to be considered in terms of findings of this report. A removal of 95% of the soluble phosphate from the flow of about 50 MGD over a six month period was observed after minor process modification was made. The secondary effluent phosphate as phosphorus had been decreased from about 19 mg/l to less than 0.5, wasting the waste activated sludge directly to the sludge treatment facilities with the digested sludge resulted in this increased phosphate removal. To examine this phenomenon a little more fully a series of laboratory tests were made using two-meter beakers. The results showed that as air rates increase from 4.7 to 18.5 cubic foot per gallon quicker precipitation of the phosphate was observed in addition to swifter nitrification and a rapid rise of the pH to about 7.6 followed by a steady increase to about 7.9 in 7 to 9 hours. (Hancuff-Texas)
W70-10378

HYDRAULIC FIELD TESTS ON A SETTLING BASIN,
Research Inst. for Water Resources Development, Budapest (Hungary).
L. Muszkalay.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-18. 6 p, 5 fig, 3 ref.

Descriptors: *Settling basin, *Hydraulics, Testing, Statistics, *Retention, Design, Efficiency, Time, Distribution, Statistic processes, *Settling basins.

The hydraulic behavior of settling basins equipped with a row of weirs as a distribution system has been determined for the time of residence, based on observed discharges. The function is analogous to the flow-thru hydrograph determined by the continuous ploting of a tracer material. Mathematically and physically defined hydraulic deficiencies, the standard deviation of time of residence and distribution of flow velocities can be determined with the help of this function. Below the design discharge of 50LPS hydraulic efficiencies were found to deteriorate rapidly, owing mainly to the non-uniform design of the weirs. In the range of 40 to 75 LPS the design range hydraulic efficiencies were found to remain fairly constant accompanied by small scatter of the lines of residence. Within the design range the basin is capable of accommodating changes in discharge. Conditions of settling are rather low. Efficiency can be raised by improving the weirs. (Hancuff-Texas)
W70-10379

OBSERVATION OF THE VIRUS BINDING CAPACITY OF SLUDGE,
Royal Veterinary and Agriculture Coll., Copenhagen (Denmark).
E. Lund.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-24. 5 p, 2 tab, 5 ref.

Descriptors: *Viruses, *Sludge, *Digestion, Activated sludge, Sewage treatment, Waste water treatment, Microorganisms, Isolation.
Identifiers: *Binding capacity.

The virus binding and inactivating capacity of activated sludge treatment is reported to have been studied in experiments where a known quantity of virus has been added to sludge samples in a pilot plant system or in a sewage plant. Such experiments have also been carried out in order to get an estimate from a quantitative point of view and have furnished much useful information. Artifically virus contaminated systems and the methods applied to recover virus from these may not be relevant however in connection with the naturally occurring viruses. These may be present in the sewage in a different way. A number of observations regarding the virus binding capacity in sludge are made. A comparison is made between virus isolation from sludge samples and influent and effluent swab samples. The effluents samples contained, when virus is demonstrated, the same types of Coxsackie B strains as the effluents. But ECHO strains are demonstrated more frequently in the effluent than in the raw sewage influent. The Adenovirus strains were found only in the influent samples. When comparing the recovery of virus from samples by means of 2 hours against 24 hour absorption periods there was no higher percentage of virus positive cell cultures. A fractionation of sewage samples by means of centrifugation is also discussed. (Hancuff-Texas)
W70-10380

THE FULL-SCALE RECLAMATION OF PURIFIED SEWAGE EFFLUENT FOR THE AUGMENTATION OF THE DOMESTIC SUPPLIES OF THE CITY OF WINDHOEK,
National Inst. for Water Research, Pretoria (South Africa).
L. R. J. Van Vuuren, M. R. Henzen, G. J. Stander, and A. J. Clayton.
Fifth International Water Pollution Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-32. 9 p, 5 fig, 4 tab, 8 ref.

Descriptors: *Sewage treatment, *Waste water treatment, *Tertiary treatment, *Water reuse, *Water quality, Water supply, Algae, Activated carbon, Adsorption, Filtration, Chlorination, Chemical precipitation, Flocculation, Flotation.
Identifiers: Windhoek, South Africa.

In early September 1968, a critical situation in water supply and demand developed which necessitated the expeditous conditioning of a full-scale water renovation plant. The reclaimable sewage effluent is derived from a conventional sewage treatment plant comprised of primary sedimentation by filtration, secondary sedimentation followed by further biological purification in 9 maturation ponds in series. Total hydraulic retention time is 14 days. The reclamation plant constitutes an integral part of the existing water treatment works and is comprised of recarbonation, algae flotation, foam fractionation, chemical flocculation, break point chlorination, clarification, sand filtration and activated carbon. The reclaimed water after carbon absorption is mixed with purified raw water and the clear water supply. The add mixed strains are then post-chlorinated to a free residual of 0.2 ppm and then pumped to the city's service reservoirs. The total cost for the production of reclaimed water including fixed capitol, chemical and running costs, amount to 11.9 cu pm, while the average costs for purified dam water are 10.7 cu pm. The cost figure for carbon treatment is based on a single use of the carbon medium without regeneration resulting in a high cost. If regeneration facilities are provided it is estimated that the total cost for reclaimed water will be 9.53 cu pm. (Hancuff-Texas)
W70-10381

CONTRIBUTION TO THE PROBLEM OF BIOFLOCCULATION IN THE ACTIVATED SLUDGE PROCESS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Zurich (Switzerland).
G. Peter, and K. Wuhrmann.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-1. 9 p, 5 fig, 1 tab, 9 ref.

Descriptors: *Sewage treatment, *Activated sludge, *Flocculation, Waste water treatment, Microbiology, Microorganisms, Colloids, Stablization, Particle size.
Identifiers: *Bioflocculation, Polyelectroytes, Destabilization.

Investigations with 16 bacterial strains, isolated from activated sludge, revealed that the phenomena involved in the process of flocculation can be best understood under the assumption of bacterial cells representing protected dispersoids. Stability of aqueous suspensions of bacteria is therefore not or not essentially a function of double layer repulsion. Bridging by chain (DEAE, Dextran, Sulfate) or particulate (Bentonite) polymers is the predominant mechanism for the flocc formation in bacterial suspensions, and has already been proposed by earlier authors. Various factors presumably interfering with the absorption of polymeric flocculation agents on the cell surfaces were studied (Type and growth phase of organisms, pH, electrolyte concentration, partical size, type of polymer, etc.). There is evidence that humic acid polymers are as effective as flocculation agents in activated sludge. It is assumed that in practical plant operations the formation and polymerization of humic acids may represent determining parameters for the clarification of the effluents. (Hancuff-Texas)
W70-10382

AN ENZYMATIC TECHNIQUE TO DETECT SURPLUS PHOSPHORUS UPTAKE BY ACTIVATED SLUDGE,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
E. G. Fruh, W. E. Morgan, H. G. Moore, Jr., R. B. Higgins, and M. L. Shahan.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-2. 14 p, 12 fig, 6 tab, 14 ref.

Descriptors: *Phosphorus, *Enzymes, *Activated sludge, Measurements, Test procedures, Waste water treatment, *Sewage treatment, Metabolism, Kinetics, Chemical precipitation, Sorption.

An alkaline phosphatase bioassay technique procedure is evaluated for use in detecting surplus phosphorus uptake by activated sludge cultures. This evaluation is based on both batch and continuous flow bench scale units. All of the experiments conducted indicated a general relationship existing between alkaline phosphatase activity and surplus phosphorus. High enzymatic activities and low cellular phosphate are associated with low influent phosphorus concentrations; low enzymatic activities and high cellular phosphorus are associated with intermediate and high influent phosphorus concentration. However, no quantitive relationship was found during the experiments relating enzymatic activities to cellular phosphorus. The long term continuous unit indicated a biological selection process was always present. Bacteria with phosphorus requirements suited to the influent phosphorus concentration predominated. This normal continuous selection process in mixed bacterial cultures increases the difficulties encountered in evaluating metabolic relationships and perhaps may have masked any quantitative result that could or did exist in these experiments. These experiments did not indicate a practical quantitative relationship between alkalinity and phosphotase and cellular phosphorus for evaluating surplus uptake of phosphorus for mixed bacterial cultures, i.e. activated sludge. (Hancuff-Texas)
W70-10383

EFFECT OF FOREIGN COMPONENTS ON THE PRECIPITATION OF PHOSPHATE BY ALUMINUM,
Rutgers - The State Univ., New Brunswick, N.J.
Wen Lin Yuan, and Pa Ho Hsu.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-16. 12 p, 8 tab, 13 ref.

Descriptors: *Chemical precipitation, *Phosphate, *Aluminum, Effects, Fluoride, Kaolinite, Montmorillonite, Waste water treatment, *Coagulation.
Identifiers: Polymers.

Aluminum salts can be used as coagulants to precipitate phosphates from waste water. This report presents evidence indicating that many other components such as sulphate montmorillite and kaolinite can react with hydroxyaluminum polymer in a similar manner as phosphate ion. In the presence of sulphate precipitation is greatly improved in all samples of p/Al ration equal to 0.3 or below. Thus aluminum dosage can be less critically controlled. In the presence of fluoride the effective phosphate precipitation is achieved only when the amount of fluoride equals the residual positive charge on the hydroxyaluminum polymers. Phosphate precipitation is also proved in the presence of montmorillonite in samples of p/Al more ratio equal 0.3 or below, but considerable amounts of phosphate remain in the solution in most samples. pH of phosphate precipitation varies with the nature and concentration of formed components present. Consequently pH adjustment is not a reliable criterion for controlling phosphate precipitation. The worst effects indicated by foreign components are attributed to two mechanisms of opposing effects: (1) foreign components tend to neutralize the residual positive charge on the polymers and thus precipate both phosphate and aluminum together and (2) these components can compete against phosphate in reacting with hydroxyaluminum polymers thereby reducing the effect of the phosphate precipitation. (Hancuff-Texas)
W70-10384

MICROBIOLOGICAL ASPECTS OF SEWAGE TREATMENT,
Institut Pasteur, Paris (France).
H. Leclerc, A. Perchet, C. Savage, S. Andrieu, and R. Nguematcha.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-23. 8 p, 6 tab, 7 ref.

Descriptors: *Microbiology, *Microorganisms, *Sewage treatment, Waste water treatment, *Pathenogenic bacteria, Salmonella, Mycobacterium, Yeasts.
Identifiers: Parasites, Saprophytic organisms, Hydromycetes.

Up to the present the dangers involved in the handling of numerous microbial pathogenic species, has not seemed to be of great concern to those responsible for treatment of sewage. This study assesses the importance of the risk of infection by defining different kinds of organisms obtained in sewage and by studying their fate during the treatment most commonly applied to liquid sewage or sewage sludges. The samples studied were taken from 18 biological sewage works distributed throughout the whole area of French territory. An impressive variety of pathogenic microorganisms were found to be present in sewage. As a rule these organisms are climinated and concentrated in the sludge. This is true in the case of Salmonella, and for most parasites and fungi. On the other hand Mycobacteria as a whole are found with equal frequency in sewage effluent and in the sludge. Anaerobic digestion, although eliminating between 90 and 99.9% of the total number of entero-bacteria, allow the Salmonella to survive in 75% of the cases; anaerobic digestion must be followed by natural drying in open air before they disappear entirely. Recommendations are presented as to microbiological testing as well as the microorganisms which should be investigated during an inspection. (Hancuff-Texas)
W70-10385

WATER RE-USE IN THE RUHR VALLEY WITH PARTICULAR REFERENCE TO 1959 DROUGHT PERIOD,
Ruhrverband, Essen (West Germany).
H. W. Koenig, G. Rincke, and K. R. Imhoff.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-4. 8 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Water re-use, *Water supply, *Water quality, Standards, *Domestic water, Tertiary treatment, Waste water treatment, Water treatment, Groundwater recharge, Droughts, Runoff, Rainfall.
Identifiers: Ruhr Valley (Germany), Bigge Reservoir, Lippe River, Ruhr River.

Two million people live in the Ruhr catchment in which considerable industrilization has developed. Prior to discharge waste water is mechanically and biologically treated. Four river impoundments provide for tertiary treatment. In summer, river flow is augmented by reservoir discharge. Water works abstracted the mixed river water and obtain drinking water by groundwater recharge. The system described insures a water in adequate quanties and acceptable drinking quality is available at all times to the 5 million inhabitants and various industries. In 1929, the reuse of 300% was experienced without detrimental effects. In December 1959 hard detergents and ammonia could not be sufficiently decomposed at 86% reuse. In October of 1959 65% reuse still gave acceptable conditions. These figures were related to a water consumption of 150 meters per capata per day. After completion of the Bigge Reservoir the reuse factor would not exceed a maximum of 22%, if a recurrence of the 1959 drought were to occur. No difficulties have resulted from this reuse. (Hancuff-Texas)
W70-10386

THE SEASONAL ACCUMULATION OF SOLIDS IN PERCOLATING FILTERS AND ATTEMPTED CONTROL AT LOW FREQUENCY DOSING,
Aston Univ., Birmingham (England).
H. A. Hawkes, and M. R. N. Shepherd.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-11, 8 p, 5 fig, 1 tab, 10 ref.

Descriptors: *Trickling filter, Control, Seasonal, *Dosing frequency, Sewer treatment, Waste water treatment, Ecology, Efficiency, Films.
Identifiers: *Suspended solids, *Solids accumulation.

In trickling filters treating domestic sewage a regular accumulation of solids occurred each winter, this accumulation being greater the colder the winter. Below 10 deg a few degrees difference in the average winter bed temperature results in considerable differences in theamount of solids present. The subsequent unloading of the filter is greatly accelerated by the active raising of the macro-inter-bed fauna at times of rising temperature. A test with low frequency dosing limited the winter accumulation of solids in the surface layer of the filter and also reduced significantly the population of fly larva, thus reducing the potential fly nuisance. The optimum frequency for any filter is determined by the hydraulic conditions of retention time and by the need to maintain the desirable ecological balance. (Hancuff-Texas)
W70-10387

NITRIFICATION IN TREATMENT PLANTS AND NAUTRAL WATERS: SOME IMPLICATIONS OF THE THEORETICAL MODELS,
Water Pollution Research Lab., Stevenage (England).
A. L. Downing, and G. Knowles.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-8. 8 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Nitrification, *Sewage treatment, *Amonia, *Activated sludge, Nitrate, Kinetics, Nitrite, *Mathematical models, Waste water treatment, Temperature, Dissolved oxygen, Rivers, Estuaries.
Identifiers: Natural waters, Nitrobactor, Nitrosimonas.

With increasing expenditures being devoted to pollution control in many counties it is important that the self-purification process governing the fate of ammonia in natural waters be throughly understood. Examination of the influences of nitrification, in particular natural waters, to determine which of the possible kinetic models best represent the real situation. If the basic concept of the theory put forward to account for the behavior of nitrifying activated sludge plants is that the population of nitrifying bacteria in the sludge will alter according to the difference between the rate of growth of nitrifying organisms in the parts of the plant in which the concentration of dissolved oxygen is adequate and their rate of removal as a result of withdrawl of surplus sludge and loss of sludge particles in the effluent. These two rates are related to the operation conditions. In a river, it is implied that a partically nitrified effluent will have a more severe effect on the oxygen resources than if no nitrification were achieved. Different interpretations of kinetics of nitrification in a relation to estuaries can conveniently be examined in terms of simple steady state model which the estuary is assumed to consist of a series of uniformly mixed segments. If the bacterial growth kinetics govern the situation the oxygen resources of the system may be more severely taxed by a process of nitrification in partially nitrified sewage influents or discharge. (Hancuff-Texas)
W70-10388

THE USE OF PLASTIC MATERIAL AS A MEDIUM FOR TRICKLING FILTERS TREATING DOMESTIC SEWAGE,
L. Audoin, J. P. Barabe, G. Brebion, and B. Huriet.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-16. 10 p, 10 fig, 1 tab, 7 ref.

Descriptors: *Trickling filters, *Sewage treatment, *Plastics, Materials, *Domestic wastes, Waste water treatment, Depth, Hydraulics, Efficiencies, Organic loading, Pilot plants, Biochemical oxygen demand.

The removal of organic load in two units of 3 pilot trickling filters filled with 'Cloisonyle' tubes was studied at different rates with either identical cross sections and different depths or identical volume and depths. The performance was as high as 9 kilograms of BOD removed per cubic meter of filter per day without recirculation. Experiments have shown that for settled sewage depth beyond 3 meters has practically no effect on performance and removal efficiency of the organic load. This conclusion is based on studies with constant organic loads and with constant superficial hydraulic loadings. It concluded that large removal of organic loads can be obtained with low pumping costs (100 to 150 watt hours per kilogram of BOD removed), since the high efficiencies indicated up to 9 kilograms BOD per meter cube per day did not require recirculation of the effluent. This removal of 9 kilograms BOD pcm corresponds to a maximum applied load of 20 kilograms of BOD pcm/per day. The superficial hydraulic loading utilized in this study varied from 0.54 to 5 cubic meters per square meter per hour. (Hancuff-Texas)
W70-10389

B.O.D. REMOVAL AND NITRIFICATION OF ANAEROBIC EFFLUENT BY ACTIVATED SLUDGE,
Technion - Israel Inst. of Tech., Haifa.
A. Melamed, C. Saliternik, and A. M. Wacks.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-18. 8 p, 6 fig, 11 ref.

Descriptors: *Nitrification, *Anaerobic conditions, *Activated sludge, *Denitrification, Kinetics, Mathematical models, Oxidation, Nitrite, Biological treatment, *Biochemical oxygen demand.

Due to the increasing significance of nitrogen remval in waste treatment, research was carried out on nitrification and denitrification as a powerful tool for nitrogen removal. It is suggested that the effluent nitrified in the aerobic unit may be recycled through the anaerobic one, thereby achieving the removal of nitrogen. In this report performance of the aerobic part of the system, namely the activated sludge process, was investigated. Kinetics of BOD removal and of nitrification were studied independently. A model (Michaelis Menten equation) based on enzyme kinetics and mixed cultures is used. For BOD the removal rate was 1.5/days. The half removal rate constant was 21 mg/l giving correlation coefficient of 0.92. For nitrification, that is ammonia to nitrate and nitrite to nitrate, the respective values were 2.49/days and 0.37 mg/l ammonia as nitrogen and 0.25 mg/l nitrite as nitrogen. The respective correlation coefficients were 0.87 and 0.91. (Hancuff-Texas)
W70-10390

HIGH QUALITY REUSE WATER FROM A NEWLY DEVELOPED CHEMICAL-PHYSICAL TREATMENT PROCESS,
New York Univ., Bronx.
A. H. Molof, and M. M. Zuckerman.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-21. 21 p, 10 fig, 9 tab, 34 ref.

Descriptors: *Water reuse, Waste water treatment, *Activated carbon, *Filtration, *Chemical precipitation, Sewage treatment, Water quality, Absorption, Phosphate, Pilot plant.
Identifiers: Chemical-physical treatment, Z-M process, Water renovation.

A pilot plant study is made of a chemical-physical treatment process. The raw waste water is mixed with 8% calcium hydroxide slury to obtain a pH of 11.5. Mixing is provided by a propeller mixer and there is retention time of about one minute. A solid separator for flocculation and clarification maintains a surface loading of 560 GPD/sq ft. Sludges are moved continuously at a rate of 0.7 GPM. The liquid then passed to a hydraulic reaction chamber which has a detention time of about 80 minutes. From there the hydrolized waste water is passed into a neutralization tank for 7 minutes where 93% sulphuric acid is added and a pH of 7 maintained. The water is pumped to a sand filter operated at 3.2 GPM/sq ft and then to 5 downflow activated carbon absorber columns of 2 foot depth at a loading of 2.2 GPM/sq ft. Disinfection is obtained through ozonation. From this study it can be seen the process can produce 97% COD removal and greater than 95% phosphate removal. Total costs are about 19.5 cents per thousand gallons. (Hancuff-Texas)
W70-10391

MARINE WASTE DISPOSAL AT RIO DE JANEIRO--WATER QUALITY EVALUATIONS AND DESIGN,
Engineering-Science Inc., Arcadia, Calif.
E. C. Peixoto, C. A. Volpi, and J. Scherfig.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper HA-10. 8 p, 2 fig, 5 ref.

Descriptors: *Waste water disposal, *Evaluation, *Sewage treatment, Estuaries, Water quality, *Design, Waste water treatment, *Flotation.
Identifiers: Marine disposal, *Flotables, *Air flotation, Rio de Janeiro (Brazil).

The optimum design of an ocean disposal system is that combination of treatment and offshore dilution which meets the required receiving water quality criteria at the lowest overall cost for the life of the system. The most important factors which determine the optimum design are: (1) characteristics and treatment of the sewage, (2) oceanographic characteristics of the disposal site, (3) cost of treatment, (4) cost of outfall operation. Preliminary studies for the city of Rio de Janeiro indicated that significant reductions in overall cost of sewage disposal could be expected if effective flotables removal process, without separate sludge handling, could be incorporated in the system. A dissolved air flotation pilot plant was constructed and a total of seventeen tests were conducted under various operating conditions. The influent to the dissolved air flotation unit was degritted, screened and had undergone primary settling. The two independent variables evaluated in these tests were overflow rate in the air flotation tanks which varied between 2,000 GSFD and 6,000 GSFD and the amount of dissolved air released from the total influent to the air rotation tank. Little or no reduction in the concentration of the flotables occurred in these tests when the concentration of the influent was less than 0.80 mg/l. No significant variation in flotables removal with overflow rate in the flotation tank was observed. The amount of air released effected flotables removal significantly 0 to 3.4 m released air per liter showed significantly lower removal than 5.6 to 37.2 ml per liter. Effluent flotables concentration below 1 mg/l can be considered excellent and in higher effluent concentration may be satisfactory. (Hancuff-Texas)
W70-10392

RESPIROMETRIC DETERMINATION OF BOD,
Government Industrial Development Lab., Sapporo (Japan).
T. Nakata, and Y. Kumagai.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-22. 8 p, 5 fig, 1 ref.

Descriptors: *Biochemical oxygen demand, *Respiration, Instrumentation, *Oxygen demand, Aerobic bacteria, Measurements, *Microorganisms, Mathematical models.

The construction and efficiency of a respirometer and the results of some experiments concerning the microorganisms are presented. The apparatus consists of a reaction chamber as master controller, a measuring unit and a recorder. The reaction chamber includes a culture flask with a magnetic stirrer inside and a small vessel for carbon dioxide, absorbant, a manometer for sending a pressure signal to a relay circuit and an electrolytic oxygen

generator with a copper sulphate electrolyte. When dissolved oxygen in a sample is consumed by microorganisms the same amount of carbon dioxide as that of the oxygen consumed is evolved by the respiratory action of the microorganism. The absorption of the carbon dioxide by the absorbant causes a decrease of pressure in the closed reaction system and the change of level of dilute sulphuric acid in the manometer closed the relay circuit. The oxygen generator produces oxygen which is fed to the reaction system at a constant rate until the initial pressure is restored. The amount of consumed oxygen is hence proportional to the intregral electroysis time. This method is known to be convenient to speedy measurements. Using glucose the BOD can be determined within 10 to 15 hours. At 20 deg if the measurement is taken at a higher temperature the result can be obtained in a few hours. (Hancuff-Texas)
W70-10393

MODULATION OF THE OXYGEN SUPPLY IN AN ACTIVATED SLUDGE PROCESS,
Degremont S. A., Malmaison (France).
J. Bernard, and R. Louboutin.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper II-6. 8 p, 9 fig 3 ref.

Descriptors: *Oxygenation, *Activated sludge, Irritation, Sewage treatment, Waste water treatment, Biological treatment, Efficiencies, Performance.
Identifiers: *Modulation, Blowers, Surface aerators.

Oxygen supply systems should be designed to take into account the following facts: (1) variation of the liquid level in the aeration tanks, (2) variation of the number of tanks in use, (3) variation in time, temporarily or permanently, of the nominal head-loss of the air diffusion devices, (4) variation in the pressure conditions and ambient air temperature, (5) variation in number of air-generating units in use. The influence of these various parameters differ according to the sources of oxygenation employed. The positive displacement air blowers, centrifugal blowers, and mechanical surface aerators are discussed, with this in mind. The ability to vary rotary blowers to modulated rotary blowers by the use of multispeed motors make-up air compressors and continuous speed variation, is discussed. The modulation of centrifugal air blowers is discussed from the standpoint of insertion of local head-losses, modification of the inlet aerodynamic conditions of the blowers, electrical motor speed control, and adjusting both speed and inlet conditions of the blower. Modulation of surface aerators is also discussed. (Hancuff-Texas)
W70-10394

QUANTITY AND QUALITY RELATIONSHIPS FOR COMBINED SEWER OBERFLOWS,
San Francisco, Calif., and Engineering-Science, Inc., Oakland, Calif.
A. O. Friedland, T. G. Shea, and H. F. Ludwig.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-1. 16 p, 5 fig, 5 tab, 2 ref.

Descriptors: Monitering, *Flow, *Hydrology, *Mathematical models, *Hydrograph, *Storm runoff, Storage, Waste water treatment, Water pollution, Water quality.
Identifiers: Combined sewage.

The results of a one year program of wet and dry weather monitoring of five combined sewer systems and one storm sewer system in San Francisco, is presented. The time concentration profiles of combined sewage constituents follow a definite three-phase variation initially having characteristics of raw sewage increasing in the second phase to 125 to 200% of the characteristics of raw sewage, and receding in the third phase to levels of 10 to 25% of the characteristics of raw sewage. No correlation was found between the mass emission of constituents due to storm and the antecedent dry period, land use character, or rainfall intensity. Storm runoff emission equations for COD total suspended solids total nitrogen, ortho-phosphate phosphrous. Hexane extractable material and floatables can be used in conjuntion with dry weather flow, waste load cooefficient, a rainfall history, basin acreage and population to estimate waste water loads. Weather diversions contain twice the total nitrogen and ortho-phosphate phosphrous, 50 to 60% more total nitrogen and COD, 20% more floatables, and 10% more total suspended solids than the storm runoff fraction of the diversion alone would contain. The nitrogen and phosphrous emissions from secondary forms are significantly greater than emissions of these constituents from combined or storm sewage flows on an annual basis. (Hncuff-Texas)
W70-10395

BIOLOGICAL MONITORING OF THE EFFLUENT FROM A LARGE CHEMICAL WORKS IN A RIVER WHICH HAS SOURCES OF POLLUTION UPSTREAM,
Canadian Industries Ltd., Montreal (Quebec).
N. E. Cooke, R. M. Cooper, and T. W. Beak.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-28. 6 p, 2 fig, 4 ref.

Descriptors: *Monitoring, *Water pollution control, Rivers, Mathematical models, Probability, Statistics, Waste water treatment, Testing, Sampling.
Identifiers: *Biological monitoring, *Chemical pollution.

In order to protect themselves and reassure the control authority some forward looking chemical companies are undertaking biological monitoring before and after plant start-up. The effluent was to be discharged into the St. Clair river, where there was already considerable pollution. To complicate the development of the system to monitor the effluent from the new plant the existing pollution in the river was of a random nature indicating that there were intermittent discharges, or spills of pollutants from the industries situated upstream. Mathematically, the problem was to find a statistical method which would enable the company to separate the effects of its plant effluents from the random effects of other effluents coming down from upstream. The invertebrate fauna found on the bottom consisted almost entirely of Chironomidae Pelecypoda, Gaftropoda, and Oligiochaeta. Due to the presence of pollution the more sensitive organisms had already been eliminated. A series of charts were developed which would indicate the differences between the averages from upstream and downstream locations in each biological survey. This permits one to detect a significant change caused by material discharged through the outfall in spite of very large fluctuations in the number of animals caused by random discharges of polluting materials released upstream. (Hancuff-Texas)
W70-10396

PRECIPITATION OF PHOSPHATES FROM WATER AND WASTE WATER USING LANTANUM SALTS,
North American Rockwell Corp., Canoga Park, Calif. Atomics International Div.
H. L. Recht, M. Ghassemi, and E. V. Kleber.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-17. 12 p, 9 fig, 1 tab, 9 ref.

Descriptors: *Chemical precipitation, *Waste water treatment, *Water treatment, *Phosphates, *Tertiary treatment, Sewage treatment, Hydrogen, Ion concentration, Efficiencies, Soluability.
Identifiers: *Lanthanum, *Chemical treatment, Secondary treatment.

Lanthanum salts were investigated for precipitation of phosphates from water. Tests were made using pure solutions of ortho- and condensed phosphates and on secondary effluent. The results compared to results from similar tests using aluminum salts. With Lanthanum (III) residual phosphate in all cases tested was considerably lower over a much broader pH range than with Aluminum (III). La (III) unlike Al (III) was effective at natural waste water pH levels of 7 to 8. At a constant pH of 7, orthophosphate removal was directly proportional to quantity of added La (III), and their use for the treatment of waste water on a wide scale will not be limited by any supply shortage. Because the lanthanide salt will be expensive compared to aluminum or to alum, even with widescale application, their use in the treatment of waste water will probably require provisions for the recovery and re-use. (Hancuff-Texas)
W70-10397

PHYSIOCHEMICAL AND MICROBIOLOGICAL PROPERTIES OF URBAN STORM WATER RUNOFF,
Swedish Inst. for Surface Chemistry.
For primary bibliographic entry see Field 05G.
W70-10398

EXTENT OF POLLUTION BY STORMWATER OVERFLOWS AND MEASURES FOR ITS CONTROL,
Ministry of Construction, Tokyo (Japan).
K. Inaba.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper HA-8. 7 p, 4 fig, 1 ref.

Descriptors: *Water pollution, *Storm runoff, *Sewage, *Hydrology, *Hydrographs, Ponds waste water treatment, Mathematical model, Sewerage control, Water pollution control.
Identifiers: *Combined sewage.

A study of the quantity and quality of storm sewage from a combined sewerage system in Tokyo metropolis, was conducted in the period 1966-1967. Three interconnected aspects of the study are discussed: (1) the hourly variation of storm sewage and storm water quantity and quality in urban areas, (2) some considerations on the method of estimating these factors, (3) the control of storm sewage flow and quality. It is important to estimate the hourly variation of storm sewage or storm water quality as a function of rains at all intensities so that accurate measures can be taken for control based on a sound mathematical model. The several possibilities are investigated and it is concluded that in a combined system it was most economical and reasonable to divide the total pollution in storm sewage between the outfall sewer to the treatment works, a storage tank and storm sewage outflows. (Hancuff-Texas)
W70-10399

DEMINERALIZATION OF WASTE WATER BY ION EXCHANGE,
Los Angeles County Sanitation District, Calif.; and Federal Water Pollution Control Administration, Cincinnati, Ohio.
J. D. Parkhurst, C. Chen, C. W. Carry, and A. N. Masse.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-20. 15 p, 8 fig, 7 tab.

Descriptors: *Demineralization, *Waste water treatment, *Ion exchange, Performance, *Tertiary treatment, *Costs, Pilot plants, Efficiencies, Water supply, California.
Identifiers: Advanced waste treatment, *Regeneration, Total dissolved solids, Pomona (Calif.).

An ion exchange pilot plant was successfully demineralized waste water at Pomona, California, for almost three years. Cost estimates for the ion exchange process shows that blended water with 1/3 the influent total dissolved solids removed can be produced at a cost competitive with alternative sources of water in southern California. The system

consists of a two stage ion exchange process which reduces the influent TDS by 90%. After 500 cycles of operation no discernable decrease in efficiency of the unit has occurred. Activated carbon absorption regeneration levels are 1.1 lbs of sulphuric acid per cubic foot for the cation resin and 0.56 lbs of aqueous ammonia for the anion resin. These have produced regeneration efficiencies of 85 to 90% respectively. Brines total approximately 11% of the influent flow and backwash wastes total about 4%, but these can be recycled through the pretreatment system. Estimated costs including carbon pretreatment to produce a blended water of 667 mg/l TDS from an influent stream of 1,000 mg/l TDS is about 23 cents per thousand gallons. (Hancuff-Texas)
W70-10400

METHOD FOR MEASURING AEROBIC DECOMPOSITION ACTIVITY OF ACTIVATED SLUDGE IN AN OPEN SYSTEM,
Research Inst. for Water Resources Development, Budapest (Hungary).
Peter Farkas.
Fourth International Conference on Water Pollution Research, Prague, Czech., September 2-6, 1968. Preprint, Sec, II, Paper 1. 9 p, 6 fig, 1 tab, 15 ref.

Descriptors: *Activated sludge, *Kinetics, *Oxygen demand, Aerobic treatment, Measurement, Respiration.
Identifiers: *Aerobic decomposition, Sludge activity.

Methods of sludge activity measurement are of great significance, since the activity indicates the concentration of living bacteria in the sludge, and its physiological conditions. The best index for sludge activity would be the substrate removal rate itself, if it were possible to measure it in a direct and simple way. An activity measurement procedure was elaborated relying upon the measurement of changes in the steady-state DO concentration of continuously aerated sludge samples. For decomposition activity measurement only substrates supplying oxygen deficiency curves with a sharp breakdown at their total removal may be used, since only in the case of such substances can the decomposition time be determined exactly. Decomposition activity shows linear proportionality to the bacterial concentration of the sludge. Acetate was added to sludge samples in concentrations ranging from 50 to 200 mg/l in order to obtain decomposition times ranging from 80 to 300 min; acetate being in excess above a concentration of 50-100 mg/l, the measured activities depended mainly on the sludge concentrations. The activity vs. substrate concentration functions were found to be different for the non-toxic acetate and the toxic compound, phenol. In the case of acetate, above a concentration of about 100 mg/l, activity was nearly independent of the value of acetate supply. With phenol, the activity vs. substrate function showed a maximum value at 20 mg/l, higher concentrations exerting a toxic effect and thus reducing activity. (Aguirre-Texas)
W70-10402

WATER POLLUTION AND THE TEXTILE INDUSTRY,
W. J. Cosgrove.
Canadian Textile Journal, Vol 87, No 1, 1970, p 63-66. 1 tab.

Descriptors: *St. Lawrence River, Biochemical oxygen demand, Hydrogen ion concentration, Algae, *Entrophication, Neutralization, Sedimentation, Trickling filters, Waste water treatment.
Identifiers: *Textile mill wastes, Montreal, Balancing tanks.

There was a dramatic reduction in the incidence of typhoid fever due to improvements in water supplies in the years 1906 to 1923, at which time the importance of typhoid carriers was discovered. The City of Montreal now faces problems of sewage disposal and the formation of algal blooms in near by rivers and lakes. The textile industry is one of several sources of wastes which adds to the problem. The BOD's and pH's of typical textile wastes are tabulated. About three quarters of the textile plants discharge their wastes to sewers and the remainder to rivers. Treatments used for textile wastes depend upon balancing tanks, neutralization, sedimentation, trickling filters and the use of specific operations and chemical treatments dectated by the particular processing operations and chemicals involved. (Work-North Carolina State)
W70-10427

HOLLOW FIBER PERMEATORS IN INDUSTRIAL WASTES STREAM SEPARATIONS,
Du Pont de Nemours (E. I.) and Co., Wilmington, Del.
W. P. Cooke.
Desalination, Vol 7, No 1, 1969, 31-46, 13 fig, 3 tab, 2 ref.

Descriptors: *Waste water treatment, Osmosis, *Water reuse, *Membrane processes, Membranes.
Identifiers: Pulp mill wastes, Sugar refinery wastes, Whey, Nylon fibers.

Hollow nylon fibers having diameters of about 45-50 microns are useful as the basis of water permeation equipment. The basic principles involved are well known and calculations of through put is easily made. Performance depends upon area, pressure, temperature, the permeability coefficient of the membrane for water, the osmotic pressure across the membrane and the thickness of the wall of the tubular fibers. It is considered that this type of installation may have useful applications in the purification of waste waters which pose problems when emptied directly into streams. Examples given are for whey processing, pulp mill wastes and sugar refinery wastes. (Work-North Carolina State)
W70-10431

TEXTILE EFFLUENTS AND THEIR SAFE DISPOSAL,
N. A. P. Perera.
Silk and Rayon Industries of India Vol 12, No 11, 1969, 555-574, 7 diag, 6 tab, 41 ref.

Descriptors: Cotton, Acids, Suspended load, Heavy metals, *Waste disposal, *Waste water disposal, Waste water treatment.
Identifiers: *Textile mill wastes, *Dyehouse wastes, Man-made fibers, Desizing, Kier scouring, Bleaching, Mercerizing, Dyeing, Silk, Silk degumming, Wool, Wool scouring, Wool grease, Jute, Rayon, Nylon, Acrylic fibers, Cellulose acetate fibers.

Polluting materials from the processing of textiles are (1) acids and alkalis, (2) organic matter, (3) toxic materials, especially compounds of heavy metals such as lead, copper chromium and the like, (4) suspended solids, (5) oils and greases, and (6) dyes and other colorants. Treating methods are (1) physical such as screening and settling, (2) chemical such as neutralizing or other chemical reactions and floculation and precipitation and (3) biological. These several treating methods are discussed and examples of operatins are illustrated with diagrams and flow charts. The processing if described of cotton fabrics by desizing, kier boiling, bleaching, mercerizing and dyeing with the waste products to be expected. Silk degumming and bleaching are discussed. Scouring of raw wool and recovery of wool grease, the retting of flax and the scouring and dyeing of jute are covered. The behavior of detergents, new developments in this field and the disposal of these materials in waste waters are presented. The manufacture of cuprammonium rayon the dyeing of this and also viscose rayon, the manufacture of cellulose acetate fibers, nylon fibers, acrylic fiber, are touched upon from the standpoint of process chemicals and the disposal of wastes. Laundry wastes and their handling are discussed. Examples of the recovery of useful products such as potassium salts and grease from wool scouring, arsenates and phosphates and d alizarin dye from other process are described. (Work-North Carolina State)
W70-10432

TREATMENT OF WASTE FROM POLYESTER MANUFACTURING OPERATIONS,
Fiber Industries, Inc., Charlotte, N.C.; and Davis and Floyd Engineers, Inc., Greenwood, S.C.
C. E. Steinmetz, and W. J. Day.
Chamical Engineering Progress, Symposium Series Vol 65, No 97, 1969. p 188-190.

Descriptors: *Water reuse, *Reclaimed water, Organic compounds, Chemical wastes, Ion exchange, Biochemical oxygen demand, Chemical oxygen demand, Color, Activated sludge, Algae, Waste water treatment.
Identifiers: *Polyester fibers, Man-made fibers, Methyl alcohol, Ethylene glycol, Polymers, Dimethyl terephthalate.

This is a progress report to May 1969, on a water reuse project, jointly undertaken by the Shelby Plant of Fiber Industries, and the FWPCA. This plant applies a lubricant, or so-called 'fiber finish', to the polyester fiber manufactured there. It is of a proprietary nature but for purposes of waste treatment schemes may be considered a long chain fatty acid or derivative thereof. This material, blow down water from the power plant, and small amounts of chemical wastes, including methyl alcohol, ethylene glycol, dimethyl terephthalate, low molecular weight polymer and titanium dioxide, ion exchange recharge chemicals, housekeeping and laboratory wastes are the essential waste products. In a pilot plant study the waste water previously treated in an extended aeration activated sludge system is further treated. As received it has a color of 50 units, C.O.D. of 280-300 ppm and B.O.D. of 8-24 ppm. Algae are removed by screening and a carbon unit reduces the color to 10 units, C.O.D. to 125 ppm and B.O.D. to 4 ppm. One half of this water is discharged and the rest returned to the system after cooling and removal of chromium and zinc salts. (Work-North Carolina State)
W70-10433

TREATMENT OF WASTES FROM COTTON TEXTILE INDUSTRY,
V. Rama Rao.
Technology, Special Issue 3, Vol 4, p 56-58, 1966.

Descriptors: *Cotton, Pretreatment (Water), *Coagulation, Lime, Gypsum, Settling basins, *Filtration, Filters, Separation techniques, Waste water treatment.
Identifiers: Bleaching, *Dyehouse wastes, Fibrous solids, Suspended solids.

The volume of waste water discharged from 87 cotton textile mills at Ahmedabad (India) varies between 10,000 and 3,000,000 gallons per day. Waste waters are chiefly from bleaching and dyehouse operations and contain fibrous and suspended solids. Owing to great variations in the characteristics of the waste water, it is not appropriate to mix it directly with sewage and to treat them in a combined treatment plant. The modified pretreatment methods of waste treatment in each plant were worked out, which consists of coagulation by lime and gypsum followed by sedimentation and filtration through a gypsum filter. (Livengood-North Carolina State)
W70-10434

WASTE DISPOSAL BY TEXTILE PLANTS,
Chatham Mfg. Co., Elkin, N.C.
Arthur L. Smith.
Water Pollution Control Federation Journal, Vol 37, No 11, p 1607-1613, November 1965. 3 fig, 3 tab.

Descriptors: *Biochemical oxygen demand, Acidity, Alkalinity, Suspended load, Dissolved solids,

Color, Foaming, Toxicity, Scum, Water pollution, Equalizing reservoirs, Flow control, Temperature control, Anaerobic digestion, Waste storage, Aeration, Hydrogen ion concentration, *Waste disposal, Waste water treatment.
Identifiers: *Textile wastes, Antibacterial finishes, *Dyehouse wastes.

The biochemical oxygen demand, acidity or alkalinity, suspended solids, dissolved solids, color, foam, toxicity, and bacteriostatic materials are the major water pollutents from textile operations. Solids may be removed by mechanical, physical-chemical, or semibiological methods. Secondary treatment may include pH adjustment, chemical or time equalization, flow or temperature control, anaerobic lagooning, and aeration. The current trend in textile waste treatment is toward the aeration technique. Treatment operations at plants of the Chatham Manufacturing Company and J. P. Stevens Company are discussed. Biochemical oxygen demand, scum, and dissolved oxygen content problems are emphasized. (Lonon-North Carolina State)
W70-10435

PLANT FOR TREATMENT OF EFFLUENTS.
Ames Crosta Mills and Co., Heywood (England).

Textile Manufacturer, Vol 89, No 1057, p 34, January, 1963.

Descriptors: *Waste water treatment, Screens, Solid wastes, *Pulp wastes, Neutralization, Settling basins, Chemical precipitation, Flocculation, Biological treatment, Activated sludge, Biochemical oxygen demand, Sludge, Trickling filters.
Identifiers: *Textile mill wastes, Balancing tanks.

In designing a waste treatment plant, it must first be decided whether treatment could be reduced within the mill itself. However, this decision is limited in textile operations, as textile wastes are derived from necessary removal of material from the product. Screening removes large solids and fibrous matter. Neutralization should precede settlement. Further chemical treatment, precipitation and flocculation, if needed, must be followed by settlement. Biological treatment, using trickling filters or activated sludge, is often necessary to remove excessive biochemical oxygen demand and must be followed by settlement. Chemical wastage and increased sludge production, which often occur because of inadequate treatment, justify careful consideration of a suitable treatment plant. Balancing tanks should be considered. (Work-North Carolina State)
W70-10436

A REVIEW OF THE LITERATURE OF 1966 ON WASTE WATER AND WATER POLLUTION CONTROL,
C. M. Weiss.
Journal Water Pollution Control Federation, Vol 39, No 7, p 1049-1154, July 1967. 917 ref.

Descriptors: *Waste water treatment, *Biological treatment, *Water pollution control, Fish, Toxicity, Fresh water, Pulp wastes, Pesticide residues, Herbicides, Estuaries, Water quality, Detergents, Algal control, Industrial wastes, Thermal pollution, Methodology, Instrumentation, Sea water.
Identifiers: Metal toxicity.

A review of papers published during 1966 is presented. Material covered includes: biological studies evaluating water pollution, causes of fish mortality, toxic nature of substances in fresh water, water quality, detergents as related to algal growth and fish damage, domestic and industrial waste treatment, metal toxicity assay, effect of wastes from the pulping and forest industries, the potential hazards from pesticide and herbicide residues, effect of thermal discharges, physiological and pathological conditions in fish caused by toxic compounds, methodology and instrumentation, and estuarine and marine pollution. (Livengood-North Carolina State)
W70-10437

5E. Ultimate Disposal of Wastes

DISPOSAL OF BRINE BY SOLAR EVAPORATION: DESIGN CRITERIA,
New Mexico State Univ., Las Cruces.
C. G. Keyes, Jr., W. S. Gregory, N. N. Gunaji, and J. V. Lunsford.
For sale by Supt. of Documents, U S Government Printing Office, Wash., D C 20402 - Price $1.25 per copy. Office of Saline Water Research and Development Progress Report No 564, May 1970. 123 p, 15 tab, 30 fig, 52 ref, 5 append. OSW Contract No 14-01-0001-969.

Descriptors: *Brine disposal, Evaporation, Energy balance, *Mathematical models, *Computer models, Solar radiation, Heat balance, Heat budget, Waste water disposal, Brines, Water temperature, New Mexico, Desalination plants.
Identifiers: *Evaporation rates, Brine evaporation, Design criteria, Solar ponds, Evaporation basins, Roswell (New Mexico).

Design criteria for disposal of brine by solar evaporation was investigated. A heat transfer model and a diffusion model were used as the main components of the criteria. Model studies showed that the use of a small depth resulted in higher brine temperatures. A 2-inch depth gives an average difference of six degrees centigrade throughout the year for conditions at the Roswell, New Mexico ponds. The heat transfer model was also useful in predicting the surface temperature of deeper basins. A wind directional analysis was used to acquire insight into the proper orientation for the influent disposal basin. The results of this analysis indicated that a Roswell basin should be constructed with its longitudinal axis on an azimuth of 165 degrees. (See also W70-09355 and W70-09243) (Rinne-Office of Saline Water)
W70-10085

MARINE WASTE DISPOSAL AT RIO DE JANEIRO--WATER QUALITY EVALUATIONS AND DESIGN,
Engineering-Science Inc., Arcadia, Calif.
For primary bibliographic entry see Field 05D.
W70-10392

TEXTILE EFFLUENTS AND THEIR SAFE DISPOSAL,
For primary bibliographic entry see Field 05D.
W70-10432

WASTE DISPOSAL BY TEXTILE PLANTS,
Chatham Mfg. Co., Elkin, N.C.
For primary bibliographic entry see Field 05D.
W70-10435

5F. Water Treatment and Quality Alteration

POTABLE WATER WITH BULRUSHES: NEW STRATEGY AGAINST WASTE WATER PROBLEMS.
Northeastern Wisconsin Regional Planning Commission, Appleton; and Scientific Translation Service, Ann Arbor, Mich.

Trans. from German (Medical Tribune). n. d. 6 p. Supported by a HUD grant.

Descriptors: *Potable water, *Bulrush, *Water pollution treatment, *Waste water (Pollution), Phenols, Industries, Nutrients, Metabolism, Organic matter, Toxins, Biochemistry, Assay, Tracers, Self-purification, Water treatment, Coliforms, Enteric bacteria, Salmonella, Eggs, Water quality.
Identifiers: Metal salts, Rhine (Germany), Central Africa, Scirpus lacustris, Heterotrophism, Lindau (Germany), Phytoncides, Polycyclic phenolcarboxylic acid.

The Lindau Public Works Department on the Rhine instigated extensive test series with phenol concentrations of varying degrees under different conditions based on information that bulrushes (Scirpus lacustris) remove metal salts as well as phenols from waste water. They proved that bulrushes not only thrive in phenol-containing water but showed improved growth at higher phenol concentrations; S lacustris evidently utilized phenol extracted from the water as a nutrient or agent for synthesis. Only at an extreme phenol concentration of 900 to 1000 milligrams/liter did the bulrushes exhibit inhibited growth or mortality. Using quantitative and qualitative biochemical assays and tracer techniques biochemists confirmed that the bulrush can use the toxins as building blocks for its protein, for example, synthesize aspartic acid or alanine from waste water phenol. The bactericidal action of the bulrush is attributed to a phytoncide, one fraction of which has already been enriched; evidently this is the acid fraction of the plant, apparently a polycyclic phenolcarboxylic acid. Large-scale projects based on this principle would mean degradation of city wastes by a growth of bulrushes along meandering waterways as a third treatment stage. (Jones-Wisconsin)
W70-10406

5G. Water Quality Control

JOINT CONFERENCE ON PREVENTION AND CONTROL OF OIL SPILLS.
American Petroleum Inst., New York; and Federal Water Pollution Control Administration, Washington, D.C.

Available from NTIS as PB-194 395, $3.00 in paper copy, $0.65 in microfiche. Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Institute, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Institute, New York, 1970. 345 p. FWPCA Project 15080 EIL---12/69.

Descriptors: *Oily water, *Water pollution sources, *Water pollution treatment, *Water pollution control, Monitoring, Surfactants, Water analysis, Biodegradation, Path of pollutants, Ecology, Data storage and retrieval, Data collections.
Identifiers: Oil spills.

On December 15-17, 1969, a Joint Conference on Prevention and Control of Oil Spills was held under the cosponsorship of the American Petroleum Institute and the Federal Water Pollution Control Administration. The objectives of the conference were to delineate the overall dimensions of the oil spills problem, explore the present state of the art of prevention and control of oil spills, and review the relevant research and development efforts of government and private industry, both here and abroad. The topics discussed include spill prevention, boom design, mechanical removal, chemical additives, analysis and sampling, monitoring, beach cleanup, fate of spills, ecological effects, and oil-spill information retrieval and dissemination. (See also W70-10036 thru W70-10049). (Knapp-USGS)
W70-10035

UNITED KINGDOM MINISTRY OF TECHNOLOGY WORK ON OIL POLLUTION,
Warren Spring Lab., Stevenage (England).
J. Wardley Smith.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 27-40, 1970. 14 p, 3 fig, 4 tab.

Descriptors: *Water pollution sources, *Water pollution treatment, *Water pollution control, Oily water, Oil industry, Ships, Oil wells, Oil-water interfaces, Oil wastes, Beaches.
Identifiers: Oil spills, United Kingdom.

The work of the research laboratories of the United Kingdom Ministry of Technology in the field of oil pollution is described. It includes the removal of oil from beaches and from the sea, the burning of oil in tanks, and the use of booms in sheltered waters. In 1960, there were a number of fairly large-scale oil pollution incidents off the south coast of England. Treatment of oil on beaches, methods of dealing with oil on the sea, the burning of oil in tanks, the use of booms to protect particular sites, and other means of preventing oil from reaching the surface of the sea are described. (See also W70-10035). (Knapp-USGS)
W70-10037

OIL POLLUTION CONTROL ON THE BUFFALO RIVER,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Observation Sciences Dept.
Ronald L. Frank.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 129-136, 1970. 8 p, 10 fig, 1 tab, 1 ref.

Descriptors: *Water pollution control, *Water pollution treatment, *Oily water, Rivers, New York, Aeration, Water pollution sources.
Identifiers: Buffalo River (N Y).

Two main systems were developed to control oil pollution on the Buffalo River, N.Y.: the upper river system uses surface oil booms and the lower river system uses an underwater air barrier. The basic design of the air barrier is discussed, along with the results of laboratory and field testing. The sampling and analysis phase of oil retrieval and the use of surface chemical displacing compounds are summarized. (See also W70-10035). (Knapp-USGS)
W70-10038

CHEMICAL TREATMENT OF OIL SPILLS,
Federal Water Pollution Control Administration, Edison, N.J. Water Quality Lab.
E. J. Struzeski, Jr., and R. T. Dewling.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 217-222, 1970. 6 p, 2 tab, 19 ref.

Descriptors: *Water pollution control, *Water pollution treatment, *Oily water, Surfactants, Absorption, Burning.
Identifiers: Oil spills, Oil spill treatment.

Chemical treatment methods have been used at all recent major oil spills with varying degrees of success. Technical information is presented on the applicability and effectiveness of the various chemicals and materials presently available for preventing and for controlling oil spills. Special emphasis is given to techniques designed to absorb and gel oils floating on the water surface, to sink oils, and to permit burning of the oil mass upon open waters and affected shorelines. The impact, consequences and damages of small and large oil spills are briefly mentioned. (See also W70-10035). (Knapp-USGS)
W70-10039

STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.; and Bureau of Commercial Fisheries, Ketchikan, Alaska.
P. C. Walkup, L. M. Polentz, J. D. Smith, and P. L. Peterson.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 237-248, 1970. 12 p, 1 fig, 6 tab, 5 ref.

Descriptors: *Water pollution control, *Water pollution treatment, *Oily water, *Cost analysis, Equipment, Cost-benefit analysis, Surfactants, Decision making.
Identifiers: Oil spills.

A cost effectiveness analysis was performed for equipment, materials, and techniques for the removal of spilled petroleum products from the surface of port and harbor waters used by U.S. Naval craft. Effectiveness criteria, formulated for present methods and presently available equipment and materials, included speed of application, completeness of removal, ease of operation, effect on marine life, operating continuity, and availability. Parameters for the effectiveness study were based on the petroleum products now in use or those planned for future use and a detailed review of the geographic, hydrographic, physical, and environmental characteristics of ports used by the U.S. Navy. The two most cost-effective systems for broad application were found to be mechanical recovery of spilled material by surface suction devices, supplemented by mechanical containment, and the application of chemical dispersants by pier- or vessel-mounted high pressure spray equipment. (See also W70-10035). (Knapp-USGS)
W70-10040

CONFINEMENT AND CONTROL OF OIL POLLUTION ON WATER WITH MONOMOLECULAR SURFACE FILMS,
Naval Research Lab., Washington, D.C. Chemical Oceanography Branch.
William D. Garrett.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 257-261, 1970. 5 p, 8 fig, 1 tab, 7 ref.

Descriptors: *Oily water, *Water pollution control, *Monomolecular films, *Surfactants, Water pollution treatment, Octadecanol.
Identifiers: Oil spill treatment.

Under favorable conditions monomolecular surface films can be used to guide, confine and condense petroleum spills on water. Composed of water-insoluable, non-toxic organic material, these films spread rapidly and spontaneously into a one-molecule-thick layer. Consequently, small quantities of film material will clear thin oil layers from large areas of a water surface. The effects of wind, the chemical character of the pollution and its thickness upon the usefulness of the film is discussed. In addition to clearing water surfaces of oil, one of the most useful applications may be the ability of the surface film to confine and condense a small oil spill into layers as thick as one centimeter. Since the petroleum is thickened and compressed into a much reduced surface area, the efficiency of oil retrieval techniques would be enhanced. (See also W70-10035). (Knapp-USGS)
W70-10041

NEW METHODS FOR COMBATTING OIL SLICKS,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (Netherlands).
F. H. Meijs, L. J. Schmit Jongbloed, and H. J. Tadema.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 263-269, 1970. 7 p, 13 fig.

Descriptors: *Oily water, *Water pollution control, *Water pollution treatment, Absorption, Surfactants, Burning, Equipment, Ships.
Identifiers: Oil spill treatment.

A new device was developed to clean spilled oil from water. It incorporates the principle of continuous operation by means of a floating and circulating absorbent belt. The apparatus operates satisfactorily under practical conditions on inland waters. Oil slicks at sea can be sunk by means of sand that has been rendered oil-wet by the addition of special wetting agents. This can be accomplished in one fast operation by using a sea-going hopper dredger which first gathers the sand from the sea bottom and stores it still wet in its hoppers. At the site of the oil slick, after fluidization of the sand with water and addition of a small amount of chemical, the sand/water slurry is sprayed over the floating oil. This method was shown to have practical potential by large-scale tests with a dredger. Both from an economic and an operational point of view, this seems to be the only potentially viable way of attacking really large oil spills on the sea. (See also W70-10035). (Knapp-USGS)
W70-10042

POLLUTION CONTROL AT A MAJOR OIL SPILL,
Union Oil Company of California, Los Angeles. Dept. of Air and Water Conservation.
T. H. Gaines.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY; published by American Petroleum Inst, New York, p 271-280, 1970. 10 p, 2 tab, 4 append.

Descriptors: *Oily water, *California, *Water pollution treatment, Oil industry, Water pollution control, Surfactants, Burning, Oil fields, Oil wells.
Identifiers: *Oil spills, *Santa Barbara Channel (Calif), Oil spill treatment.

The eruption of crude oil from the ocean floor five and one-half miles offshore from Santa Barbara, California on January 28, 1969, created a substantial task of pollution control and property cleanup. In spite of all difficulties encountered, the beaches, harbors, houses, boats and shoreline have been restored, and in some cases, exceed their original beauty and cleanliness. The cleanup has been costly and time-consuming. More than $4,500,000 has been spent in the prevention of pollution and restoration of property and the environment. (See also W70-10035). (Knapp-USGS)
W70-10043

IDENTIFICATION OF OIL SPILLS: COMPARISON OF SEVERAL METHODS,
Melpar, Inc., Falls Church, Va.
For primary bibliographic entry see Field 05A.
W70-10044

REMOTE SENSING OF OIL SLICKS,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Water Quality Research.
For primary bibliographic entry see Field 05A.
W70-10045

MICROBIAL MODIFICATION OF CRUDE OIL IN THE SEA,
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 05B.
W70-10046

MICROBIAL DEGRADATION OF NORMAL PARAFFIN HYDROCARBONS IN CRUDE OIL,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 05B.
W70-10047

KINETICS OF DISSIPATION AND BIODEGRADATION OF CRUDE OIL IN ALASKA'S COOK INLET,
Alaska Univ., College. Inst. of Marine Science.
For primary bibliographic entry see Field 05B.
W70-10048

FLUID DYNAMICS OF FLOATING OIL CONTAINMENT BY MECHANICAL BARRIERS IN THE PRESENCE OF WATER CURRENTS,
Shell Pipe Line Corp., Houston, Tex. Research and Development Lab.
Moye Wicks, III.
Proceedings of Joint Conference on Prevention and Control of Oil Spills, American Petroleum Inst, and Federal Water Pollution Control Admin, Dec 15-17, 1969, New York, NY, published by American Petroleum Inst, New York, p 55-106, 1970. 52 p, 1 fig, 2 tab, 26 ref, 4 append.

Descriptors: *Running waters, *Water pollution control, *Oily water, Computer programs, Water pollution treatment, Oil industry, Laboratory tests, Ships, Oil-water interfaces, Oil wastes, Currents (Water), Turbulence, Flow, Open channel flow, Hydraulic models, Flumes.
Identifiers: Oil spills.

Experiments on oil containment by mechanical barriers led to identification of the important physical phenomena controlling the extent of an oil slick and illustrate flow conditions leading to failure of the barrier. A mathematical model has been developed to generalize the experimental results. Three regions in the oil layer are identified. A gravity wave region near the upstream end of the slick, which leads to oil droplet formation if water flows faster than a certain critical speed; a boundary layer region where drag of the flowing water causes gradual thickening of the oil; and a skirt region where the flowing water causes oil droplets still present to be swept under the barrier. Failure is also possible when oil can escape under the boom by a kind of draining action. Example calculations and design charts are presented to be used in deciding whether stationary mechanical barriers would work at all in given cases, and in selecting the proper depth of skirt and length of boom required in those cases where mechanical barriers are feasible. Where stationary barriers are not feasible, the results can be used to establish minimum boom drift velocity to prevent oil from escaping. (See also W70-10035). (Knapp-USGS)
W70-10049

WATER IN URBAN PLANNING, SALT CREEK BASIN, ILLINOIS--WATER MANAGEMENT AS RELATED TO ALTERNATIVE LAND-USE PRACTICES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04C.
W70-10070

SIMULATION OF SPATIAL AND TEMPORAL CHANGES IN WATER QUALITY WITHIN A HYDROLOGIC UNIT,
Montana State Univ., Bozeman. Dept. of Civil Engineering; and Utah Water Research Lab., Logan.
N. Dixon, and D. W. Hendricks.
Water Resources Bulletin, Vol 6, No 4, p 483-497, July-August 1970. 15 p, 2 fig, 5 tab, 12 ref. FWQA Grant No WPD-17-03.

Descriptors: *Mathematical models, *Systems analysis, *Water management (Applied), *Water resources development, Simulation analysis, Water quality, Water yield, Aquifers, Reservoir operation, Reservoir design, Waste water disposal, Waste disposal, Water pollution control, Utah, Gaging stations, Data collections, Sampling, Hydrogeology, Computer programs.
Identifiers: Water resources management.

Water quality must be considered in the development and planning aspects of water resource management. To accomplish this, the decision-maker needs to have at his disposal a systematized procedure for simulating water quality changes in both time and space. The simulation model should be capable of representing changes in several parameters of water quality as they are influenced by natural and human factors impinging on the hydrologic system. A water quality simulation model was developed in conjunction with a hydrologic simulation model. The model represents water quality changes in both time and space in response to changing atmospheric and hydrologic conditions and time-varying waste discharges at various points in the system. This model has been developed from and verified with actual field data from a prototype system. Procedural guidelines are given to assist in the development of water quality simulation models as tools for use in the quality-quantity management of a hydrologic unit. (Knapp-USGS)
W70-10077

EFFECTS OF WATER IMPOUNDMENTS ON REPRODUCTION AND POPULATION NUMBER OF WATERFOWL ON THE SNAKE RIVER, WASHINGTON,
Washington State Univ., Pullman. Dept. of Wildlife Biology.
For primary bibliographic entry see Field 06G.
W70-10117

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF STREAM WATER QUALITY STANDARDS, VOLUME II,
Iowa State Univ., Ames. Engineering Research Inst.
M. D. Dougal, E. R. Baumann, and J. F. Timmons.
Available from NTIS as PB-194 551, $10.00 in paper copy, $0.65 in microfiche. Completion Report ISU-ERI-Ames-6400, April, 1970. 646 p, 120 tab, 88 fig, 330 ref. OWRR Project A-001-IA (6).

Descriptors: Economics, *Mathematical models, Path of pollutants, *Waste assimilative capacity, *Water quality, *Water pollution control, *Biochemical oxygen demand, Computers, Dissolved oxygen, *Quality standards, Rivers, Sewage treatment, Simulation, Streams.

A comprehensive study is reported of water pollution control and stream water quality as they relate to the establishment of stream and effluent standards. The ability of Iowa streams to assimilate organic wastes was determined on a state-wide basis, with three hydrologic-water quality regions being identified: Ideal, Good, and Poor. Quantitative values were assigned for low flow discharges in each region. The preliminary results indicate that the BOD loading in the streams must be limited to 10 - 15 mg/l to maintain the established dissolved oxygen standard of 4 mg/l. The physical characteristics of effluents from typical waste treatment processes were determined and related to mathematical models for BOD progression. A more refined BOD model was developed. A case study of the Skunk River at Ames revealed the nature of the response of an Iowa stream to discharge of effluents from a water pollution control plant. A digital computer model was developed for simulating, verifying and forecasting stream water quality. The results indicate three major factors influence stream quality: oxidation of the carbonaceous organic wastes contained in effluents, nitrification of nitrogenous compounds, and the effect of nutrient levels in causing a substantial algal response. The economic value of water pollution control was evaluated for the City of Ames. Present annual expenditures will double or triple in the future depending on the desired level of stream water quality. (See also W70-06094)
W70-10123

SELECT RESERVOIR WITHDRAWAL BY MULTILEVEL INTAKES,
Army Engineer District, Savannah, Ga.
For primary bibliographic entry see Field 08A.
W70-10147

EFFECTS OF RESERVOIR IMPOUNDMENT ON WATER QUALITY,
Army Engineer District, Savannah, Ga.
Frank H. Posey, Jr., and Joseph W. DeWitt.
Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 96, No PO1, p 173-185, Jan 1970. 13 p, 5 fig, 10 ref, 2 append.

Descriptors: *Reservoir storage, *Reservoirs, *Impoundments, Intakes, *Water quality, Submerged weirs, Effects, Thermal stratification, *Water quality control, Stratification, Withdrawal, Outlets, Aeration, Pumping, Tailrace, Turbines, Dissolved oxygen, Reservoir operation, Reaeration.
Identifiers: Effect, Multilevel outlets, Diffused air pumping system, Selective level releases, *Destratification (Thermal).

Correcting adverse effects of thermal stratification and low dissolved oxygen content in large reservoirs, and controlling physical, chemical, and biological parameters of released water from impoundments in the southeastern United States are described. Results of water quality investigations at the Clark Hill and Hartwell Reservoirs are outlined along with predictions of quality expected at West Point Reservoir. Comparisons are made of various possible corrective solutions investigated such as: (1) multilevel penstock intakes, (2) submerged weirs, (3) tailrace and turbine aeration, and (4) destratification systems. Emphasis is placed on a diffused air pumping system prototype equipment test at Allatoona Reservoir in northern Georgia. The destratification equipment and types and methods of sampling and data processing are described. (USBR)
W70-10148

CONTROL OF AQUATIC PLANT NUISANCES (ESPECIALLY ALGAE) WITH SOME SUBSTITUTED PHENYLUREAS,
Ivonne J. Le Cosquino de Bussy.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 539-545, 1969. 1 fig, 4 tab, 9 ref.

Descriptors: *Aquatic plants, *Nuisance algae, *Algicides, *Phenols, *Water quality control, Crustaceans, Rotifers, Swimming pools, Chlamydomonas, Daphnia, Diatoms, Chlorella, Scenedesmus, Oxygen, Coliforms, Sediments, Mud, Sands, Sludge, Recreation.
Identifiers: *Phenylureas, Diuron, Flagellates, Monuron, Transparency, Cyclops, Scenedesmus obliquus, Dactylococcus, Escherichia coli, Oocystis, Lemna, Spirodela, Elodea.

The requirement in the Netherlands for a good means of controlling algae nuisance in open-air flow-through swimming pools or in recreational ponds, fostered research with substituted phenylureas. These herbicides are inhibitors of photosynthesis. Higher submerged water plants and filamentous algae can be controlled very well by the application of diuron in early April in dosages varying from 0.2 to 0.4 ppm. In order to control microalgae in swimming pools and to obtain a transparency of 100-250 centimeters a higher dose is necessary, the growth of Crustacea, which eat small algae being desirable at the same time. The addition of diuron should be effected in clear water preferably with an initial dose of one ppm. In smaller swimming pools the concentration of diuron must be above 0.6 ppm in order to obtain a transparency of 120-240 centimeters. In large swimming pools (6000 cubic meters) a transparency from 170-270 centimeters could be maintained even during the time when the diuron in the water was no longer detectable. (Jones-Wisconsin)
W70-10161

PHYSICAL AND MATHEMATICAL MODEL STUDIES OF SURFACE CURRENTS,
Hydraulics Research Station, Wallingford (England).
I. W. M. Moir, and J. M. Willians.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint 6 p, Fig. 2.

Descriptors: *Estuaries, *Physical models, *Mathematical models, Winds, Currents, Correlation analysis, Model studies.
Identifiers: *Surface currents, Graphical presentation.

Physical and mathematical models based on field observations have been developed for analysis of wind and tide effects on surface water currents. Investigation into sea disposal have been conducted on the Tyne and Tees estuaries and Firth of Forth. A six month program of field work was undertaken for each of the investigations. Current observations were obtained, by direct reading and recording instruments at five depths, over a tidal cycle at a number of locations. The movement of surface water was tracked by drogues. The current measurements and associated wind observations from each investigation were analyzed for correlation between wind and wind-induced currents, and for information on basic current drift in the absence of wind. A graphical method of presentation of the data is also shown in this paper. Results showed a high significance level for the basic regression equation, but low correlation coefficients, indicating considerable scatter. Further work is therefore needed to identify systematic components in the error vectors. (Upadhyaya-Vanderbilt)
W70-10206

MATHEMATICAL MODEL TECHNIQUES FOR COASTAL WATERS,
Edinburgh Corp. (Scotland).
D. Haverson.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, 5 p.

Descriptors: *Mathematical models, Potential flow, *Wind, *Currents, Tidal effects, Frequency.
Identifiers: *Coastal waters, Least squares fit, Tidal cycle.

The subject of the model is the structure of the flow patterns in the layer of water 1.5 meters below the surface of the region under investigation. Purpose of the model is to predict the track of a drogue centered in this layer, for any conditions of wind and tide. The main data consists of sets of wind/current readings, the latter at a depth of 1.5 meters, at half-hourly intervals. A relation between wind and wind-enduced current in the area is derived. Two methods are combined in the construction of the model, one based on potential theory and in the other, the tidal period is subdivided, and at each point of sub-division two surfaces are found which are best least-squares fits to the resolutions East and North of current magnitude. This is done by Fourier analysis. Two methods can be combined by applying Green's formula to the boundary data, and then adding the information gained in this way to the data already available for the least-square fit. Enough work has been done to provide strong evidence for the viability of the method. The programs are written in Fortran IV for an I.C.L. system 4-50. (Upadhyaya-Vanderbilt)
W70-10207

THE FLOW OF ROUND BUOYANT JETS ISSUING VERTICALLY INTO AMBIENT FLUID FLOWING IN A HORIZONTAL DIRECTION,
Waterloopkundig Laboratorium, Delft (Netherlands).
G. Abraham.
Fifth International Water Pollution Research Conference, San Francisco, July 26-Aug 1, 1970. Preprint, 7 p, 3 fig.

Descriptors: *Jets, *Velocity, Thermal pollution, Momentum equations.
Identifiers: *Buoyant jet, Entrainment, Drag coefficient, Drag force, Cross-flow.

Hot stack gases discharged into a cold cross-wind and jets of sewage issuing into an ocean-current are two examples of the phenomenon of a round buoyant jet into a cross-flow. In the present analysis a modification of Loh-Nien Fan's description of the entrainment is given. Describing the entrainment of round buoyant jets in a crossflow distinction must be made between a subdomain with predominant influence of buoyancy. Making this distinction the problem can be solved theoretically on basis of two separate coefficients of entrainment to express the entrainment in both subdomains and on basis of one drag coefficient to describe the drag force per unit length of jet, FD. The coefficient of entrainment for jets primarily influenced by initial momentum is taken as 0.057 and for thermals moving through stagnant ambient fluid, 0.5. The drag coefficient CD is taken as 0.3. Theoretical solutions obtained along this method were found to agree with experiments. (Upadhyaya-Vanderbilt)
W70-10209

MODELING SPREAD OF HEATED WATER OVER LAKE,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering and Hydraulics.
Heinz Stefan.
Journal of the Power Division, Proceedings ASCE, Vol 96, No PO3, Proc Paper 7375, June 1970, p 469-482. 1 fig, 1 tab, 10 ref.

Descriptors: *Thermal pollution, *Cooling water, *Thermal powerplants, Environmental engineering, Hydraulic models, Lakes, Nuclear powerplants, Outlets, Reservoirs, Temperature, Water quality, Dispersion.

Physical modeling must include three significant phenomena, mixing at the outlet, stratification, and surface heat transfer. Flow and cooling of a warm water surface layer can be represented in a model if, first, flow of water in and out of the model, and, secondly, atmospheric conditions above the model are controllable. Because the cooling process follows an exponential law, 'all' may signify 95 percent to 99 percent. Using the dimensionless equations of motion, continuity and heat transfer, similarity criteria for the flow of heated water over an essentially stagnant and colder impoundment are presented. Turbulent flow in the model, matching of reduced gravitational forces and surface heat loss as well as sufficient size of the model are considered to be most essential modeling requirement. (Upadhyaya-Vanderbilt)
W70-10212

HYPERBOLIC COOLING TOWERS, DEVELOPMENT AND PRACTICE,
Rogers-Cohen-Barreto-Marchertas, Inc., Chicago, Ill.
Paul Rogers, and Eli W. Cohen.
Journal of the Power Division, Proceedings of ASCE, PO1, Proc Paper 7030, Jan 1970, p 117-128. 18 fig, 10 ref.

Descriptors: *Thermal pollution, *Cooling towers, *Winds, Pressure, Dead loads, Foundation.
Identifiers: *Hyperbolic cooling towers, Plexiglass model, Shells, Diagonal columns.

Mathematical studies leading to membrane analysis are briefly described. The total design of a hyperbolic cooling tower involves more than the shell analysis. It includes the other major steps such as the foundations, the diagonal columns, the lintel, and the top stiffening girder. Numerous tests and measurements indicate that positive pressure exists only on a relatively small portion of the tower at the windward side. Starting at about 40 deg azimuth, the rest of the shell is under negative pressure with maximum values at about 70 deg azimuth. Smooth surfaces are subject to substantially increased negative pressures. Tests indicate that there is virtually a uniform negative pressure within the tower with an approximate value of one-half of the wind force. Aerodynamical instability should be avoided. The model tests provided information concerning the distribution of wind forces, the meridian membrane and flexural forces, the parallel membrane and flexural forces. While earthquake design is not included herein, it is recommended that the provisions of the Structural Engineer's Association of California be employed with particular emphasis to ductility and dynamic response. It is concluded that the theoretical and practical development of hyperbolic cooling towers has reached a high plateau of efficiency. (Upadhyaya-Vanderbilt)
W70-10213

SALT-WATER COOLING TOWERS QUESTIONED.

Electrical World, June 1, 1970, p 46-47. 1 fig.

Descriptors: *Cooling towers, *Saline water, *Thermal pollution.
Identifiers: Material selection, Drift.

Several areas of technical concern with salt-water towers were reported. In addition to more obvious problems of material selection, marine growth in towers, vapor-plume dispersion, and hurricane-wind design, it was noted that the presence of salt in the cooling water acts to depress vapor pressure. This retards evaporation and causes a small increase in cooling-tower size for equal performance. Because salt is damaging both to metals and to vegetation, considerable effort was spent in trying to understand the mechanism by which it is transported and deposited. Towers now available, however, are said to limit drift to a maximum of 0.2% of tower-circulated water. Using this upper limit, and with designed circulation - water requirements at the ultimate 2,384-Mw Turkey Point rating, salt could be released to the atmosphere at up to 66,600 lb. per hour. Based on 7000 hr. per year of operation, this could accumulate to 466 million lb. per year. Fouling and corrosion of electrical switch gear and control equipment would cause serious operating and maintenance problems for the operating utility. (Upadhyaya-Vanderbilt)
W70-10221

ENVIRONMENTAL POLLUTION-A SELECTIVE BIBLIOGRAPHY.
Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. Information Services Section.
For primary bibliographic entry see Field 10.
W70-10228

A REVIEW OF THE 1969 LITERATURE ON WASTE WATER AND WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 1.
W70-10267

TOWN OF FRISCO CITY V GREEN (CITY'S BURDEN OF PLEADING COMPARATIVE INJURY DOCTRINE WHERE CITY'S SEWER POLLUTES BRANCH FLOWING THROUGH DAIRY).
For primary bibliographic entry see Field 06E.
W70-10303

TASK I REPORT: SURVEY OF LARGE-SCALE HEAT REJECTION EQUIPMENT,
Dynatech R/D Co., Cambridge, Mass. Thermal Engineering Group.
John H. Carey, John T. Ganley, and John S. Maulbetsch.
Federal Water Quality Administration, Water Pollution Control Research Series, July 1969. 127 p, 31 fig, 8 tab, 86 ref. FWQA Project 16130 DHS—7/69, Contract 14-12-477.

Descriptors: *Thermal power plants, *Cooling towers, Heat, Condensers, *Thermal pollution.
Identifiers: Cooling ponds, *Heat rejection equipment.

Various types of heat transfer equipment which would be applicable to the task of dissipating condenser discharge heat from large power plants are identified. Their performance is analyzed, performance prediction methods are presented, and

the capital and operating costs are given. A brief review was made of the basic thermodynamics of the Rankine power cycle in order to provide some basis for understanding the effect of the heat rejection process on the total cycle. Information including sizing procedures, capital and operating costs, duty maintenance requirements, and possible secondary pollution considerations are presented for candidate systems such as once-through cooling (to serve as a base), cooling ponds, spray ponds, wet cooling towers, dry cooling towers, evaporation condensers, and air-cooled condensers. Operational considerations are discussed including the theory of operation at the design point, off-design performance, running procedures, and any unusual characteristics affecting the interface between the cooling system and the power plant. The material describing each of the individual units is integrated and procedures and criteria are developed for the selection of an optimum unit given a particular geographic location, capacity requirements, and economic constraints. (See also W70-10316) (Maulbetsch-Dynatech)
W70-10315

TASK II REPORT: SURVEY OF POWER PLANT OPERATING CHARACTERISTICS AND DESIGN CRITERIA,
Dynatech R/D Co., Cambridge, Mass. Thermal Engineering Group.
Ware D. Fuller, and John S. Maulbetsch.
Federal Water Quality Administration, Water Pollution Control Research Series, August 1970. 94 p, 30 fig, 15 tab, 139 ref. FWQA Project 16130 DHS--8/70, Contract 14-12-477.

Descriptors: *Electric power production, *Thermal power plants, *Nuclear power plants, Heated water, Fuels, Operating cost, Maintenance costs, Heat exchangers, Temperature, *Thermal pollution.
Identifiers: Broiler plant, Steam turbines, Steam condensers, Fixed charge rate.

This réport is part of a larger study to perform a technical and economic survey of alternate methods for cooling condenser discharge water from thermal power plants. The task reported on in this document investigates the criteria by which the power plants themselves are designed and optimized. These criteria are both technological and economic. The initial section reviews the general aspects of power plant selection. These include questions such as how the procedure of procuring a new plant is initiated, how the plant size is determined, what factors influence the choice of fuel and site location, and how the plant capacity factor and fixed charge rate are calculated. There follows a detailed review of design and cost optimization procedures. This includes a review of capital costs for the turbine-generator units and for the boilers. Operating costs are computed based on constant incremental running rates. A worked example is presented and carried to the point of a 'present worth' evaluation. A brief discussion of the use of feed-water heaters, single- and multi-pressure condensers is provided. Some operational considerations including instrumentation and control and plant layout are discussed briefly. A separately bound Appendix includes a Heat Rate Table for General Electric turbines, and Westinghouse and General Electric price lists for both conventional and nuclear turbine-generator units. (See also W70-10315) (Maulbetsch-Dynatech)
W70-10316

CITY OF CLANTON V JOHNSON (ABATABLE NUISANCE AS CONSTITUTED BY NEGLIGENT MAINTENANCE OF SEWERAGE SYSTEM).
For primary bibliographic entry see Field 06E.
W70-10330

DOUCET V TEXAS CO (RELATIVE RIGHTS OF MINERAL LESSEES AND OYSTER LESSEES).
For primary bibliographic entry see Field 06E.

W70-10353

ENFORCEMENT LIMITATIONS IN WATER QUALITY CONTROL,
Federal Water Quality Administration, Washington, D.C.
Murray Stein.
Water Resources Bulletin, Vol 6, No 4, p 473-475, July-August, 1970.

Descriptors: *Water quality control, *Limiting factors, Jurisdiction, Water Quality Act, Public health, Legislation, Water policy, Navigable waters.
Identifiers: *Enforcement.

The Federal role in enforcement of water quality requirements began with the enactment in 1956 of the Federal Water Pollution Control Act. It has been expanded by successive amendments to the act to cover the pollution of navigable as well as interstate water which endangers the health or welfare of persons, and to cover violations of water quality standards established for interstate waters. Two different enforcement procedures are prescribed in the law to be followed in the two types of enforcement actions. While questions have arisen of jurisdiction, state's rights, and disregard or duplication of local efforts, such questions do not lastingly impede the exercise of Federal enforcement authority in the Statutory distinctions between interstate and intrastate pollution which govern the application of the enforcement authority, even though a case of intrastatepollution may be as serious or more serious than a case of interstate pollution. An additional limitation, results from the statutory time intervals between procedural stages in an action. Lack of data is a limitation but can always be overcome. State laws which protect the confidentiality of required reports are also a limitation. Investigative teams may obtain the needed information, however, for consideration in public meetings. Public support for effective water quality control measures, especially enforcement, and for the expenditures needed to enhance the environment, is widespread. Such support may be instrumental in modifying or eliminating existing statutory limitations. (Mariott-Chicago)
W70-10354

LAKE MICHIGAN SHORE WATER QUALITY SURVEY 1969, REPORT TO THE GOVERNOR AND THE 76TH GENERAL ASSEMBLY.
Illinois State Sanitary Water Board, Springfield.

Illinois State Sanitary Water Board, Report to 76th General Assembly, May 1970, p 31. 3 tab, 14 fig.

Descriptors: *Water quality, *Lake Michigan, *Illinois, *Water pollution, *Beaches, Turbidity, Phosphates, Bacteria, Coliforms, Water pollution sources, Plankton, Eutrophication.
Identifiers: Lake County, Cook County, Chicago.

The results of shore water monitoring showed bacteria, turbidity, floating debris,phosphates, and ammonia nitrogen counts in 1969 substantially higher than in 1968. It is hypothesized that a 50% increase in rainfall over the year contributed to this rise by causing the Metropolitan Sanitary District to allow backflow of polluted river water into Lake Michigan. On the North shore, where beach closings were numerous and where sewage treatment plants discharge into the Lake instead of the river watershed, many plants provide only primary treatment: all are operating in excess of their design capacities. The North Shore Sanitary District is constructing new facilities which will discharge a high quality effluent into the Illinois River watershed. The MSD is developing a program to resolve its drainage problem. While adequate standards and authority to control pollutional discharges exists, new legislation is needed to assist in the implementation of plans and needed pollution control facilities. Plankton counts, an indicator of lake eutrophication, were less than half the magnitude of the 1968 averages. (Wexman-Chicago)
W70-10360

ESTUARINE CLEAN WATER COST-BENEFIT STUDIES,
International Water Pollution Research Conference (5th).
R. Stone, and H. Friedland.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper III-17. 8 p, 8 tab.

Descriptors: *Benefits, *Economics, *Evaluation, *Cost-benefit analysis, *Social aspects, Intangible benefits, Intangible costs, Social values costs, Value.
Identifiers: *Socio-economic values.

A socio-economic analysis was made of the beneficial uses of San Diego Bay in relationship to the improvement of the Bay's water quality following diversion of sewage from the bay to the Pacific Ocean in 1963. An initial approach based upon land values found that areas within 8 miles of the bay increased 27% more than land values of a zone up to 15 miles more distant. Approximate costs are tabulated of several alternatives including three degrees of treatment and diversion of effluents to the ocean. Economic benefits are stated for various recreational uses with alternative treatment programs. (No basis is given for these benefits). An 'algorithm' was derived to evaluate intangible social costs and benefits. This consists of mean weighting of social values on a non-monetary scale by a number of individuals, and the further assumption that the social intangibles thus evaluated should be given a monetary value of 60, 80 or 100% of the over all economic benefits. With these socio-economic values and various assumptions, optimum courses of action were derived. (Whipple-Rutgers)
W70-10373

PHYSIOCHEMICAL AND MICROBIOLOGICAL PROPERTIES OF URBAN STORM WATER RUNOFF,
Swedish Inst. for Surface Chemistry.
G. Soderlund, H. Lehtinen, and S. Friberg.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 1, 1970. Preprint, Paper I-2. 8 p, 18 fig.

Descriptors: *Storm runoff, *Chemical properties, *Microbiology, Sampling, Physical properties, Runoff, Nitrogen, Coliforms, Biochemical oxygen demand, Phosphorus, Water pollution effects.
Identifiers: Urban runoff, Lead, Suspended solids, Volatile solids, Sweden.

In Sweden today a separation of storm and sanitary sewers is usually preferred. This avoids the discharging of mixed storm water and waste water into the streams and inland waters. There is an increasing discussion as to whether the direct discharge of storm water into streams can be justified for the future. A study to collect more information concerning the nature and extent of the pollutional load from highly urbanized areas was made. The results of this study showed that the discharging of snow melt from heavily trafficed areas into streams and inland waters contributes in a great extent to the pollution of the recipients with oil and heavy metals. Traffic roads give a high degree of contamination as compared with the other test areas. The oil in the storm water is contaminated with oil not only from the traffic but also an unexpectedly great extent from other areas, especially the industrial areas. As the use of cutting oils and emulsions, dry cleaning liquids and industrial cleaning liquids is still increasing, since the problem of collection and destroying such waste liquids must be solved. The various measurements were taken in very different areas with respect to traffic intensity. The analytical values obtained represent a skewed distribution. Nearly 50% of the dry residue obtained from warm water runoff is volatile material, probably asphalt from the roadway, rubber from tires and oil. Other constituents measured in concentration versus time were chloride, pH, nitrogen, phosphorus, coliforms, carbohydrates, and BOD. (Hancuff-Texas)
W70-10398

THE EXTENT OF NITROGEN AND PHOSPHORUS REGENERATION FROM DECOMPOSING ALGAE,
Kentucky Univ., Lexington. Dept. of Civil Engineering; Texas Univ., Austin. Dept. of Civil Engineering; and Stanford Univ., Calif. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 05C.
W70-10405

UNITED STATES V ALASKA'S PACKING CO (PROSECUTION FOR OIL POLLUTION).
For primary bibliographic entry see Field 06E.
W70-10438

LIVEZEY V TOWN OF BEL AIR (DUTY OF MUNICIPALITY TO OPERATE ITS SEWAGE DISPOSAL PLANT IN SUCH A WAY AS NOT TO CREATE A NUISANCE).
For primary bibliographic entry see Field 06E.
W70-10441

THE PANAM (LIBEL FOR THE DISCHARGE OF OIL INTO COASTAL NAVIGABLE WATERS).
For primary bibliographic entry see Field 06E.
W70-10442

NELSON V TOWN OF NORTHUMBERLAND (TOWN'S RESPONSIBILITY TO MAINTAIN SEWERS PROPERLY).
For primary bibliographic entry see Field 06E.
W70-10445

THE SS NEA HELLIS (VIOLATION OF OIL POLLUTION ACT).
For primary bibliographic entry see Field 06E.
W70-10461

DOLLAR SS CO V UNITED STATES (DISCHARGE OF REFUSE INTO NAVIGABLE WATERS).
For primary bibliographic entry see Field 05B.
W70-10462

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

LEAST SQUARES ESTIMATION OF CONSTANTS IN A LINEAR RECESSION MODEL,
Kentucky Univ., Lexington.
L. Douglas James, and William O. Thompson.
Water Resources Research, Vol 6, No 4, p 1062-1069, August 1970. 8 p, 2 tab, 12 ref. OWRR Project A-001-KY.

Descriptors: *Statistical methods, *Data collections, *Recession curves, Gaging stations, *Streamflow forecasting, *Hydrologic data, Least squares method, Regression analysis, Base flow, Hydrograph analysis, Runoff forecasting, Model studies, Mathematical models.
Identifiers: Streamflow recession.

Least squares can be used for estimating constants in a linear recession model from published average daily streamflows. A model with two recession constants was derived and successfully tested on a number of Kentucky streams. It can be used to estimate recession constants from daily streamflows stored on magnetic tape or punched cards without resorting to time-consuming graphical techniques. Equations and procedures are provided for recessions represented by either one or two recession constants using both a weighted and unweighted estimation procedure. In applying the two techniques, empirical evidence indicates the simpler unweighted procedure is preferable. (Knapp-USGS)
W70-10052

OPTIMAL PLANNING OF A COASTAL COLLECTOR,
Technion-Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel-aviv.
For primary bibliographic entry see Field 02F.
W70-10053

LINEAR DECISION RULE IN RESERVOIR MANAGEMENT AND DESIGN 2. PERFORMANCE OPTIMIZATION,
Cornell Univ., Ithaca, N.Y.; and Geological Survey, Arlington, Va.
Charles ReVelle, and William Kirby.
Water Resources Research, Vol 6, No 4, p 1033-1044, August 1970. 12 p, 6 fig, 2 tab, 3 ref.

Descriptors: *Decision making, *Linear programming, *Reservoir design, *Reservoir operation, *Optimization, Water yield, Reservoir yield, Mathematical models, Water management (Applied), Water storage, Evaporation, Water yield improvement, Stochastic processes.
Identifiers: Reservoir yield optimization, Reservoir management.

The application of linear decision rules to reservoir management and design is extended in two directions. First, an improved linear decision rule is derived for reservoirs suffering evaporation losses. Release commitments generated by this rule are based on the storage at the beginning of the period, the predicted evaporation depth in the period, and the linearized storage area curve of the reservoir. A clearer and more rigorous derivation of the chance constraints, including the effects of both evaporation losses and possible failures to meet previous commitments, is presented. Second, several reservoir performance measures are formulated as objective functions that can be optimized linear programing. These performance measure include expected and reliable values of storages and releases, deviations from targets, and reliabilities of achieving stated goals. (Knapp-USGS)
W70-10054

LINEAR PROGRAMMING MODELS FOR ESTIMATING THE AGRICULTURAL DEMAND FUNCTION FOR IMPORTED WATER IN THE PECOS RIVER BASIN,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 06D.
W70-10055

VALUE OF STREAMFLOW DATA FOR PROJECT DESIGN-A PILOT STUDY,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins; Corps of Engineers, Sacramento, Calif; and Geological Survey, Washington, D.C. Hydrologic Systems Lab.
For primary bibliographic entry see Field 02E.
W70-10056

APPLICATION OF LINEAR RANDOM MODELS TO FOUR ANNUAL STREAMFLOW SERIES,
Alaska Univ., College; and Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02A.
W70-10069

SIMULATION-DECISION AID IN PLANNING DESALTING APPLICATIONS,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-10075

SIMULATION OF SPATIAL AND TEMPORAL CHANGES IN WATER QUALITY WITHIN A HYDROLOGIC UNIT,
Montana State Univ., Bozeman. Dept. of Civil Engineering; and Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 05G.
W70-10077

THE OPTIMIZATION OF THE OPERATION OF A MULTI-PURPOSE WATER RESOURCES SYSTEM,
Federal Water Quality Administration, Washington, D.C.; Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering; and Water Resources Engineers, Inc., Walnut Creek, Calif.
William N. Fitch, Paul H. King, and George K. Young, Jr.
Water Resources Bulletin, Vol 6, No 4, p 498-51[illegible] July-August 1970. 21 p, 6 fig, 13 tab, 10 ref.

Descriptors: *Systems analysis, *Optimization, *Water resources development, Reservoir design, Reservoir operation, Water management (Applied), Computer programs, Planning, Watershed management, River basin development.
Identifiers: Water resource optimization.

The objective of any water resource system is to transform the natural waters of a river basin into a form such that optimal use of these waters will result. Thus the water may be transformed into electrical energy, transferred in space for water supply and irrigation, transferred in time for flood control and maintenance of adequate streamflows, or simply retained for use as a means for achieving waterbased recreation. This paper discusses means for determining how a given system should be operated to maximize the net benefits. An example of the type of tradeoff which occurs in such a system is the conflict between power generation and flow augmentation. The answer to the tradeoff problem can be found by utilizing the systems approach. An algorithm is presented which optimizes the performance of a system in the context of the objective. The technique is applied to a basin to illustrate the type of answer that results from the application of the model. The optimization of a water resource system consisting of three multi-purpose reservoirs and five waste treatment facilities required 2.4 minutes of IBM 360/65 time. The system had 42 possible combinations of reservoir levels. The computer time would increase approximately in proportion to the square of the number of possible combinations of reservoir levels. (Knapp-USGS)
W70-10078

SYSTEMS ANALYSIS OF WATER SUPPLY SYSTEMS,
Michigan Univ., Ann Arbor.
Rolf A. Deininger.
Water Resources Bulletin, Vol 6, No 4, p 573-579 July-August, 1970. 7 p, 2 fig.

Descriptors: *Water resources development, *Systems analysis, *Optimization, *Groundwater, Water management (Applied), Design, Planning, Water supply, Mathematical models, Networks, Network design, Water costs, Water yield.
Identifiers: Ankara (Turkey), Groundwater resources.

Systems analysis and operations research techniques may be used for the planning, design and operation of specific parts of a water supply system. Optimal design and development of groundwater sources, particularly the operation of well fields and regional development of future supply sources are described. The question of which supplies should be developed, at what time, to what degree, and which transmission lines should be built to minimize the costs of regional water supply, are formulated mathematically. (Knapp-USGS)
W70-10080

A CRITERION FOR INVESTING IN INFORMATION,
New York Univ., N.Y.
Joel Owen.
Management Science: Application, Vol 14, No 12, Aug 1968, p B715-B720. 6 p, 2 ref.

Descriptors: *Decision making, Risks, Costs, Data, Investment.
Identifiers: Decision theory.

In numerous water resources planning situations, decisions must be made based on incomplete information. A procedure by which the decision maker can choose between two courses of action; one, to make a decision based on existing information or two, to institute a study program i.e., to invest in information before making a decision, was developed. Both choices involved risk and depended on the cost of analyzing data, the number of people involved and the value of the information gathered. Decision Theory provided a framework for the view adopted. The risks involved in the binary decision problem was defined explicitly. A model and assumptions were presented. The risk of immediate decision whereby the decision maker uses his own judgment was described. The risk of investing in information was also given. The risk or opportunity loss including the price of the study was computed and compared with the risk of immediate decision. As an aid to the decision maker unfamiliar with the specifics of the theory, answering a series of questions will allow him to determine the parameter values to be used in reaching the minimum risk action. An example was presented to illustrate the decision procedure. Comments were offered on the general use of the risk comparison concept used. (Kriss-Cornell)
W70-10151

FUNDAMENTAL ISSUES IN THE SIMULATION OF HUMAN BEHAVIOR: A CASE STUDY IN THE STRATEGY OF BEHAVIORAL SCIENCE,
Pittsburgh Univ., Pa. Graduate School of Business.
Ian I Mitroff.
Management Science: Application, Vol 15, No 12, Aug 1969, p B-635-B-649. 15 p, 34 ref.

Descriptors: *Simulation analysis, *Computers, Data, Analytical techniques, Model studies, Testing, Behavior.
Identifiers: Turing's test.

A report was presented on selected aspects of the actual growth and development of a simulation project, especially as the process affected the development of a novel method for validating simulation models. A philosophical analysis of the concept of simulation, especially as the analysis formed an integral part of the study's development was also given. The paper's main thesis was that the teleology or purpose behind the construction of the simulation model was an ever present taskmaster guiding and influencing all the phases of the model's construction and validation. One such test for validation of the model mentioned is Turing's test based on the notion of an 'imitation game'. The question asked during any test of validation were said to be the same at every level: 'What are we testing, the data or the theory by which the data was collected.' The two basic approaches to reality that investigators of simulation assume, labeled rationalism and empiricism, were discussed. Experimentalism and Man-Machine Dialectics were also described in detail. This paper has application to water resources simulation model studies in which decision makers are required to interact with the model. (Kriss-Cornell)
W70-10152

CAPACITY EXPANSION FOR INDIA'S NITROGENOUS FERTILIZER INDUSTRY,
Agency for International Development, Washington, D. C.
Donald Erlenkotter, and Alan S. Manne.
Management Science: Application, Vol 14, No 10, June 1968, p B553-B572. 20 p, 2 fig, 10 tab, 3 ref, 1 append.

Descriptors: *Project planning, *Decision making, Investments, *Demand, Chemicals, Fertilizers, *Optimum development plans, *Economies of scale, Costs, *Computer models.
Identifiers: *India.

A preinvestment survey for a massive investment program under way to meet increased demand for chemical fertilizers in India was presented. It intended to provide a rough framework within which to draw up a detailed proposal on the next few units for the chemical fertilizer industry built. The initial premises for a specific project were: when, where, and how large a plant to construct. The problem of optimal plant size centered about the fact of economies-of-scale in investment costs. An attempt was made to calculate the size, location and time-phasing for nitrogenous fertilizer capacity so as to minimize the discounted costs of satisfying future demands. Cost comparisons were made between alternative configurations of plant size and time-phasing for six refinery-oriented producing locations. A constant cycle model, rather than dynamic programming, was used to make the comparisons. An over-all cost comparison between two plant sizes was obtained through use of the basic parameter values. A static location model for 1974 was designed as a conventional type. Computer results for the model were summarized. The appendix gave the derivation of the formula extending the costs for a two-location two-phase cycle plant size model to n locations with equal increments of demand growth and identical inter-area shipping charges. (Kriss-Cornell)
W70-10153

SEPARABLE MARKOVIAN DECISION PROBLEMS,
Rand Corp.
Eric V. Denardo.
Management Science: Theory, Vol 14, No 7, March 1968, p 451-462. 12 p, 1 fig, 14 ref.

Descriptors: *Markov processes, *Decision making, *Optimization, Model studies.

Numerous water resources optimization and simulation models are based on a Markov process. The special structure of a class of Markovian decision problems was exploited to simplify the determination of optimum policies. A Markov renewal programming model was first reviewed. The special structure of Problem I was exploited in two closely interrelated ways: a streamlined Markovian decision problem called Problem II was identified and shown to be equivalent to Problem I; and Problem I was analyzed in a manner which accounted in part for the streamlining in Problem II. Two examples of separable Markovian decision processes provided illustrations of notational devices and indicated the breadth of the class of separable problems. Streamlined approaches were presented for dealing directly with the original problem and the particular inventory model example was further simplified. (Kriss-Cornell)
W70-10154

ON AN ALGORITHM FOR THE SOLUTION OF MIXED INTEGER PROGRAMMING PROBLEMS,
State Univ. of New York, Buffalo.
Stanley Zionts.
Management Science: Theory, Vol 15, No 1, Sept 1968, p 113-116. 4 p, 5 ref.

Descriptors: *Optimization, *Program, Variability.
Identifiers: Algorithm, Mixed integer programming.

A variety of mixed integer programming models have been proposed for the solution of water resources problems. Details of the author's suggestion for more compact representation of integer constraints in an algorithm for the solution of Mixed Integer Programming Problems referred to in an article by Norman J. Driebeek (Management Science, March 1966) was given. Familiarity with Driebeek's paper was assumed for the presentation. Driebeek represented an integer variable as a sum of a set of zero-one variables. Changes were made to Driebeek's algorithm and were summarized as follows: (1) Solve for the noninteger optimal. If integer halt; (2) compute the penalties as in the original paper; (3) choose a trial solution based on the penalties and proceed to it by introducing variables into the basis that are to be basic in that trial solution; (4) if a feasible integer solution is found, it should be noted and used to determine whether any further solutions need be tested as in Driebeek's algorithm. An optimal solution to the example of Driebeek, using the alteration to Driebeek's method was presented. (Kriss-Cornell)
W70-10155

STOCHASTIC SENSITIVITY ANALYSIS OF MAXIMUM FLOW AND SHORTEST ROUTE NETWORKS,
Rand Corp.
Richard D. Wollmer.
Management Science: Theory, Vol 14, No 9, May 1968, p 551-564. 14 p, 17 ref.

Descriptors: *Stochastic processes, Routing, Analytical techniques, Variability.
Identifiers: Algorithm, Maximum flow, Sensitivity problems, Max-flow Min-cut theorem.

An algorithm used to solve two types of network sensitivity problems was presented. In the first, arcs were subject to breakdowns that degrade their capacities. An undirected source-sink planar maximum flow network was given in which each arc was subject to anywhere from 0 to n breakdowns. It was required to find the maximum possible effect of n breakdowns on maximum flow. In the second, arcs were subject to improvements that reduced their lengths. A shortest route network was given in which each arc was subject to anywhere from 0 to n improvements. It was required to find the maximum possible effect n total improvements can have on shortest path length. Capacities resulting from breakdowns and lengths resulting from improvements were random variables specified by their mean values and variances. The central idea in solving of maximum flow network problems was summarized in the max-flow min-cut theorem. Justification for the algorithm used was described in detail. The algorithm would be practical provided the number of labels in each set remained small. (Kriss-Cornell)
W70-10157

DISCRETE STOCHASTIC PROGRAMMING,
California Univ., Davis.
K. D. Cocks.
Giannini Foundation Paper 282. Management Science: Theory, Vol 15, No 1, Sept 1968, p 72-79. 8 p, 4 tab, 8 ref.

Descriptors: *Linear programming, *Stochastic processes, Mathematical models, Variability, Constraints.
Identifiers: *Multistage problems, Passive programming, Active programming.

A method for solving water resources and other linear programming problems where (any number of) the functional, restraint, and input-output coefficients were subject to discrete probability distribution, was presented. The objective function was formulated in terms of variance and/or expectation. The method of stochastic programming presented was devised primarily to deal with multistage problems but, to demonstrate flexibility, the general explanation was in terms of an active programming approach and examples and a heuristic discussion was used to bring out the multistage possibilities. Initially, the prior allocation which maximizes expectation was derived and then the model was quadraticized for maximizing a function of expectation and variance or for deriving the E-V efficient set. The procedure involved the simultaneous generation of all (mutually exclusive) possible outcomes and hence the transference of all variability into the objective function of a very much enlarged linear program. This was a 'constrained passive programming' or 'constrained active programming' technique, at least in multistage applications. (Kriss-Cornell)
W70-10158

SYSTEMS OF DEMAND EQUATIONS: AN EMPIRICAL COMPARISON OF ALTERNATIVE FUNCTIONAL FORMS,
Chicago Univ., Ill.
Richard W. Parks.
Econometrica, Vol 37, No 4, p 629-650, October 1969. 8 tab, 30 ref.

Descriptors: *Demand, Statistical methods, Estimating.
Identifiers: *Indirect addilog system, *Linear expenditure system, *Differential logarithmic system, Demand equations, Consumer demand, Econometrics, Specification, Parameters.

A variety of complete systems of demand equations have been proposed for econometric use. These systems give strong allegiance to classical demand theory, and most introduce restrictions in order to simplify the model and reduce the number of parameters. Theoretically, however, none of the models dominates its competition. The choice of specification for empirical work must then be made on an empirical basis: which model performs best. This paper considers three demand models: the indirect addilog system, the linear expenditure system, and the differential logarithmic system. The paper provides a comparison of the models in terms of both their theoretical properties and their empirical usefulness. Section 2 of the paper compares the models in terms of their theoretical properties. Section 3 presents the empirical results for the models, the parameter estimates, and certain test statistics that are used to compare the empirical validity of the models. Section 4 introduces certain auxiliary statistics that allow a detailed comparison of the model's performance. This article provides a comprehensive review of factors to consider when estimating water demand equations and should be of value to research concerned with water demand estimation. (Loeb-Rutgers)
W70-10194

MEKONG DELTA MATHEMATICAL MODEL PROGRAM CONSTRUCTION,
Bologna Univ. (Italy); and Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
For primary bibliographic entry see Field 04A.
W70-10264

ANALYSIS TECHNIQUES FOR HOUSTON SHIP CHANNEL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W70-10266

AN ECONOMIC MODEL FOR A POLLUTED RIVER SYSTEM,
For primary bibliographic entry see Field 05B.
W70-10370

WATER QUALITY AND MANAGEMENT EXPERIENCES OF THE DELAWARE RIVER BASIN COMMISSION,
Delaware River Basin Commission, Trenton, N.J.
For primary bibliographic entry see Field 05B.
W70-10371

THE APPLICATION OF A LINEAR PROGRAMME MODEL TO WATER CONSERVATION AND EFFLUENT MANAGEMENT AT MODDERFONTEIN FACTORY,
African Explosives and Chemical Industries Ltd., Johannesburg (South Africa); and National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 05D.
W70-10374

6B. Evaluation Process

WATER IN URBAN PLANNING, SALT CREEK BASIN, ILLINOIS--WATER MANAGEMENT AS RELATED TO ALTERNATIVE LAND-USE PRACTICES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04C.
W70-10070

COMMUNITY LEADERSHIP AND WATERSHED DEVELOPMENT,
Mississippi State Univ., State College. Water Resources Research Inst.
K. P. Wilkinson, and R. N. Singh.
Available from NTIS as PB-194 455, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Mississippi Water Resources Research Institute, August, 1970. 62 p, 13 tab. OWRR Project A-035-MISS (1).

Descriptors: Behavior, *Watershed management, Psychological aspects, Social aspects, *Social participation.

This study was intended to assess correlates of levels of involvement of local community leaders in small watershed projects under P. L. 566. Three key actors in each of eleven completed watershed projects in Mississippi were interviewed in depth to identify actors, associations and activities. A survey was then conducted in each watershed of those persons most frequently named as having been significant actors. Detailed interview schedules were completed on 114 actors. The principal measure of the dependent variable consisted of a profile of the actor's performance of the discrete roles which had been identified through interviews with key informants. A high level of intercorrelation of this with seven alternative measures was found. Bivariate analysis gave substantial support to the general hypothesis that intensity of participation in a watershed project is related to generality of commitment to and participation in community action. Also found was a relationship between participation in the watershed project and probability of personal, economic benefit.
W70-10114

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF STREAM WATER QUALITY STANDARDS, VOLUME II,
Iowa State Univ., Ames. Engineering Research Inst.
For primary bibliographic entry see Field 05G.
W70-10123

THE ENGINEERING AND MANAGEMENT OF AN EFFECTIVE SYSTEM,
International Systems Co.
Donald S. Feigenbaum.
Management Science: Application, Vol 14, No 12, Aug 1968, p B-721-B-730. 10 p.

Descriptors: *Management, Engineering, Systems analysis, Design, Programs, Costs.

A review of engineering and management of truly effective systems with a consideration of the form taken by the systems concept today was presented. The general operational form that the concept takes was readily stated where the key to the approach of modern systems engineering, including water resources systems engineering, is that changes in equipment and manpower content; in interrelationship structure; in information flow; and in management and control of these systems must be accomplished not only in terms of their own improvement but in terms of their impact on total effectiveness. Four system characteristics were of interest: (1) systems structures have become extended, intricate, and involved; (2) the more traditional manpower, machine and information elements have been replaced and upgraded by more complex and intricate production equi ments, data processing setups and specializ professionals; (3) the economics of improveme planning has too often been based on the self ins lated cost islands of traditional bookkeeping; a (4) the total systems structures often are not und direct management and engineering control of t company. Systems management, used to integra scientific, behavioral and mathematical disciplo was described. (Kriss-Cornell)
W70-10156

RURAL-URBAN DIFFERENCES REFLECTE IN OUTDOOR RECREATION PARTICIPATIO
Forest Service (USDA)., Seattle, Wash.
John L. Hendee.
Journal of Leisure Research Vol 1, No 4, p 33 341, Autumn 1969.

Descriptors: *Outdoor recreation, *Motivatio *Use rate, Social aspects, Rural sociology, Urb sociology, Population, Values, Environment, Er ployment, Recreation demand, Economic impa Transportation.
Identifiers: *Residence participation, Populati density, Cultural differences, Familiarity.

It is pointed out that in many studies of outdo recreation residence is an important variable. Th is true in studies of water recreation where rur and urban participation differences are usually a sumed. The paper examines several theories th seek to explain this condition and finds them to b cast in general, ambiguous terms and difficult t test empirically. Many methodological problem must be overcome and the traditional lack of rigo characteristic of recreation studies, eliminated. N tional surveys have found economic and soci states, and age to be more important than residenc in recreation participation so that theories based c the latter are apt to be misleading. Future theori should be built around more theoretically justifi ble factors. (Murphy-Rutgers)
W70-10187

THE THEORY OF PRICE DETERMINATION I GOVERNMENT-INDUSTRY RELATIONSHIPS.
Louisiana State Univ., New Orleans; and Ohi Univ., Athens.
A. M. Agapos, and Paul R. Dunlap.
Quarterly Journal of Economics, Vol LXXXIV, N 1, p 85-99, February 1970. 7 fig.

Descriptors: *Governments, *Prices, *Monopol Industries, Profit, Costs, Procurement, Contract Political aspects, Employment, Legal aspects.
Identifiers: *Price determination, *Monopson *Bilateral monopoly, Output, Industrial capacity.

There have been attempts to explain monopolis monopsonist environments through vario techniques where the established objectives of tw parties are considered to be inconsistent and ir determinate. Generally, in an exchange confined t two parties, it is assumed that the one with th greatest bargaining power will theoretically dictat the outcome. The usual approach of explainin government operations with industry is the concep of bilateral monopoly, where the government is monopsonist and the contracting firm is th monopolist. The prevailing explanation is that th contractor seeks to maximize profits and th government tries to minimize costs. However, thi explanation is shown to be inadequate and hinder the understanding of the government-industry rela tionship. This paper explains how a government single source contract is different from the conve tional bilateral monopoly and then develops mathematical model for this government-industr relationship. A more general model is provided fo multisource procurements. A general mathemati cal model covering all government-industry rela tionship is supplied. As such, this is useful in th water area where government may be the sol buyer of a water resource or contractor for work o water resource projects. (Loeb-Rutgers)
W70-10188

HE EFFECTIVENESS OF REGULATION OF LECTRIC UTILITY PRICES,
ichigan State Univ., East Lansing.
homas Gale Moore.
outhern Economic Journal, Vol 36, No 4, p 365-75, April 1970. 2 tab, 9 ref.

escriptors: *Regulation, *Electricity, *Prices, rofit, Demand, Marginal costs, Estimating, Costs, onstraints.
dentifiers: *Electric utility prices, Electric utilities, arginal revenue.

he objective of this study is to measure the effectiveness of the regulatory process in reducing rices to residential users of electrical utilities. In it, he marginal cost for 62 private electric companies nd 7 municipal ones are computed and the demand curves facing them are estimated. From these unctions, the profit-maximizing prices, p sub m, re estimated and compared with the actual prices harged to indicate the effectiveness of regulation. hort run marginal cost is estimated using Federal ower Commission cross sectional data on production costs for steam plants. Demand is estimated rom cross sectional statistics on residential consumption, electricity prices, and natural gas prices. olving for the profit maximizing price by setting he marginal revenue function equal to marginal osts indicates that regulation has reduced prices nly slightly on average for the Investor Owned tilities. Municipal power companies, however, harge considerably less than the profit maximizing rice. This methodology may prove applicable to he water area when attempting to measure the effectiveness of regulation in reducing prices for the se of water supply facilities. (Loeb-Rutgers)
W70-10189

HE EXISTENCE OF AGGREGATE PRODUCTION FUNCTIONS,
Massachusetts Inst. of Tech., Cambridge.
Franklin M. Fisher.
Econometrica, Vol 37, No 4, p 553-577, October 1969. 28 ref.

Descriptors: *Aggregates, Labor, Capital.
Identifiers: *Aggregate production function, Efficiency, Capital aggregation, Production function, Labor aggregation, Output aggregation, Approximation, Fixed capital.

The estimation and use of aggregate production functions has become a widespread and important practice in economic analysis. Such uses fall into two main classes. On the one hand there has been major efforts in the estimation of aggregate production functions for entire economies, for manufacturing, for durables, etc. These papers have made empirically derived inferences about the importance of technical change; about the rate of return to investment, social or private; about the share of wages in national product; and, generally, about the technical and economic forces making for growth. On the other hand, aggregate production functions have been used to represent technical possibilities of an economy in which some intertemporal welfare function is maximized or as a basic constituent of a one or two-sector descriptive growth model. In both problems, the use of an aggregate relatonship between an output aggregate and constructs called 'labor' and 'capital' is a convenience. The author examines the circumstances under which technological relationships can be subsumed in an aggregate form and discusses the inferences from such a model and its approximation to the real world. This article would be relevant to the empirical studies of water production functions. (Loeb-Rutgers)
W70-10190

ESTIMATION OF JOINT PRODUCTION FUNCTIONS,
Pennsylvania Univ., Philadelphia; and Stanford Univ., Calif.
P. J. Dhrymes, and B. M. Mitchell.
Econometrica, Vol 37, No 4, p 732-736, October 1969. 1 tab, 1 ref.

Descriptors: Economics, Estimating, Least squares method.
Identifiers: *Estimation, *Joint production function, Canonical correlation.

In a recent paper, H D Vinod has suggested canonical correlation analysis as a technique of consistently estimating the parameters of joint production functions. While it is not clear that he intended this technique to be applicable to all possible specifications of such functions, it is presumably applicable at least to the explicity formulation he considers. In this note the authors show several things: first, Vinod's formulation contains an error; second, in the case p—q, canonical and ordinary least squares analyses are equivalent; third, if p does not equal q, then the canonical estimators cannot be consistent unless OLS estimators are as well. This paper may prove applicable to the water area in cases where econometric methods are used to estimate relations in the form of a joint production function. (Loeb-Rutgers)
W70-10191

THE COST OF CAPITAL AND INVESTMENT CRITERIA IN THE PUBLIC SECTOR,
Lehigh Univ., Bethlehem, Pa.
Eli Schwartz.
The Journal of Finance Vol XXV, No 1, p 135-142, March 1970.

Descriptors: *Capital, *Costs, *Government, *Investment, Economic evaluation, Interest rate, Discount rate, Optimization, Risk, Benefits, Taxes, Income, Debt, Prices, Profit, Economic efficiency.
Identifiers: *Pareto optimum, *Present value, Social time preference, Social benefit, Rate of return.

There has been considerable controversy regarding the problem of government investment under the assumption that biases against government spending, frictions in the capital market, and a systematic divergence between the non-risk interest rate and the rate of return required for private investment prevent an equality between marginal social time preference and marginal social benefit. This article attempts to prove that these biases are exaggerated. The market cost of capital can be used to approach Pareto optimality in rationing capital between the public and private sector. The author shows that the social cost of capital must be higher than the government's borrowing rate since the government's borrowing rate arises from the government's legal superiority as a borrower against the private holders of all claims. This paper has implications for the extent of government investment in water resources and is relevant to water studies using social discount rates for investment decisions. (Murphy-Rutgers)
W70-10192

COMMENT ON VOTING AND SOCIAL CHOICE,
Indiana Univ., Bloomington.
Alfred Broaddus.
The American Economist, Vol 14, No 1, p 45-46, Spring 1970.

Descriptors: *Welfare preferences.
Identifiers: *Voting, *Social choice, *Social welfare function, Social ordering, Transitivity, Aggregate cycling phenomenon, Binary relation, Indifference, Voting class.

The author states that Campbell's paper is a closely reasoned attempt to extend and modify the results regarding social welfare functions achieved by Kenneth Arrow. Campbell found a family of social welfare functions, neither imposed or dictatorial, satisfying a set of conditions which includes a modified version of the original Arrow conditions. Campbell's social welfare function (R sub a) or rule for passing from individual to social orderings is such that social orderings established by it are transitive. This is accomplished at the prive of including a possible aggregate cycling phenomenon (C sub a) within the definition of the binary relation R sub a. The author feels that this inclusion weakens the intuitive appeal of Campbell's results. The author believes that Arrow's Condition 4 and 5 are simply Campbell's Conditions 7 and 6, respectively. In Section 3, Campbell demonstrates that any social welfare function satisfying his seven conditions must belong to the 'voting class'. Here the relevant question is whether or not all members of the 'voting class' satisfy Conditions 1-7. The theoretical use of a social welfare function or of social orderings is implied in the water area when deciding whether or not to invest in a particular public project. (Loeb-Rutgers)
W70-10195

PUBLIC BUDGETING AND FINANCE,
Georgia Univ., Athens.
Robert T. Golembiewski.
Itasca, Illinois, Peacock Publishers, 1968, 592p.

Descriptors: *Budgets, Planning, *Economic analysis, Forecasting, Management, Government, Decision-making, Financing, Management, Costs, Taxes, Subsidies, Optimization, Model studies, Control, Social aspects.
Identifiers: *Public budgeting, *Public finance, Budgetary procedure, Economic policy, Institutional aspects, Administrative problems, PPB.

A collection of readings is presented dealing with various aspects of public budgeting. It should be of interest to the water researcher since it provides the reader with an understanding of the numerous complexities and functions of budgeting in the public sector, where much of the water resource investment occurs. It first discusses the concept of what a budget is, how well it achieves its purpose and who should prepare it. The book then explains some of the aspects of the institutional contexts of public financing and budgeting followed by a group of articles relating some of the economic policy contexts. Some of the analytic models and actual patterns of decision-making are described, as well as the control function of budgeting. There are some articles on the behavioral and organizational contexts of public budgeting and finance with a final section on the budgetary process as a form of management. (See also W70-10197 thru W70-10200) (Murphy-Rutgers)
W70-10196

BUDGETS: DEFINITION AND SCOPE,
Texas Univ., Austin.
Andrew C. Stedry.
In: Public Budgeting and Finance, Itasca, Illinois, Peacock Publishers, 1968, p 6-14.

Descriptors: *Budgets, *Economic evaluation, *Planning, *Cost, *Economic efficiency, *Control, Industrial production, Forecasting, Management, Variance, Optimization.
Identifiers: *Standard costs, *Standards, Goals, Motivations, Budget control system.

The author defines what a budget actually is and states that its two major functions are to serve as a plan for future actions and as a means of control to encourage economic efficiency. These two functions are often interlaced to the point of indistinguishability but the author believes that the equality of figures used for the control and planning budgets is not necessarily correct. The author attempts to convey the applicability of the treatment of budgets to control systems, using standards and standard costs as elements of control, by discussing the similarity of the various elements. The concluding section evaluates the process by which the control given by the budget is exercised. As a means of increasing the effectiveness of the budgetary controls in the water resource area, this article deserves the interest of the water researcher. (See also W70-10196) (Murphy-Rutgers)
W70-10197

PERSPECTIVES ON POPULATION AND RESOURCES,
Resources for the Future, Inc., Washington, D.C.
Joseph L. Fisher.

In: Readings in Resource Management and Conservation, Chicago, University of Chicago Press, p 104-109, 1965.

Descriptors: *Natural resources, *Population, Conservation, Technology, Water resources, recreation, Forecasting, Economic justification, Research and development, Irrigation, Optimization, Capital, Investment, Water pollution, Water quality, Economic impact.
Identifiers: *Economic adaptations, Resource enterprises, Population growth, Leisure time, Capital formation.

The large problems are discussed which grow out of the resources- population relationship. He cites several studies which resulted in forecasts of United States population, demand for natural resources, and resource supply problems as far in the future as 2000. A pessimistic future was indicated unless: economic adaptations of techologic trends continue, resources can be obtained from foreign sources, or resource undertakings improve in farsightedness and consistency. Resource adequacy for the United States of a resource such as water was indicated as optimistic, although problems were likely to occur, such as having enough good quality fresh water in a particular place. The author suggests that cautious optimism is indicated due to recent advances, such as interest in stream pollution, improvement in water pollution abatement techniques, and inception of water quality control based on analysis of hydrologic, chemical and economic data. However careful control over the trends and forces influencing both population and resources is suggested, so that needed changes can be made. (See also W70-10196) (Murphy-Rutgers)
W70-10198

ECONOMICS AND THE APPLIED THEORY OF PUBLIC EXPENDITURES,
Minnesota Univ., Minneapolis.
Walter Heller.
In: Public Budgeting and Finance, Itasca, Illinois, Peacock Publishers, p 170-179, 1968.

Descriptors: *Budgeting, *Economic analysis, *Government, *Public benefits, Economic efficiency, Income, Cost minimization, Taxes, Benifits, Welfare economics, Prices, Industrial production, Subsidies, Profit.
Identifiers: Public goods, Stabilization, Want-satisfying, Voter preferences.

This paper is designed to show; where the economist can offer some useful counsel on the theory of government functions as they effect the budget, to indicate some lines along which promising work is being done, and to suggest certain limitations or constraints within which the economic criteria for dividing resources between public and private use must be applied. The author classifies and defines the basic economic objectives of government and studies the problems of determining the consumer's preferences for public goods and the maximum efficiency position between public and private economic control. The various methods of satisfying public wants are discussed from the point of view of minimizing costs. The paper concludes with a brief mention of some constraints on the application of specific economic criteria. The public good aspect of water resources should make this article of interest to the water researcher. (See also W70-10196) (Murphy-Rutgers)
W70-10199

CRITERIA OF EFFICIENCY IN GOVERNMENT EXPENDITURES,
Virginia Univ., Charlottesville.
Roland N. McKean.
In: Public Budgeting and Finance, Itasca Illinois, Peacock Publishers, p 516-521, 1968.

Descriptors: *Budgets, *Economic efficiency, *Economic evaluation, *Government, Systems analysis, Decision-making, Forestry, Management, Optimization, Maximization, Value, Prices.
Identifiers: *Personnel policy, *Economic criteria.

The author is concerned with the problems of choice and criterion difficulties in the attainment of efficiency. Particular emphasis is placed on the quantitative aspects of economic analysis. The process of maximizing economic efficiency usually requires a process of suboptimization which involves numerous complications in addition to inviting piecemeal analysis in decision-making. The proper criterion in economic evaluation is maximum output minus costs. As an example the author uses forest management to demonstrate the manner in which to choose among alternative sizes of the budget as well as among alternative personnel policies. The maximization of economic efficiency through the budget process is a problem continually faced by the water resources administrator. Accordingly, this article is relevant to the water resource planning process. (See also W70-10196) (Murphy-Rutgers)
W70-10200

INCOME REDISTRIBUTION AND SOCIAL CHOICE: A PRAGMATIC APPROACH,
Bowdoin Coll., Brunswick, Maine.
A. Myreck Freeman.
Public Choice, Vol VII, p 3-21, Fall 1969.

Descriptors: *Economic evaluation, *Income, Government, Optimization, Maximization, Taxes, Marginal analysis, Cost, Cost-benefit analysis, Decision-making, Federal government.
Identifiers: *Income distribution, *Social welfare function, *Paerto optimum, Utility possibility frontier, Government transfers, Social choice, Voting, Welfare maximization.

Modern formal welfare analysis points out the impossibility of ranking alternative positions on the utility possibility frontier due to the impossibility of making comparisons of individual utilities. However, many government programs, including many water resource development projects alter the distribution of income and thus this article is relevant to the water resource area. The author attempts to show that under plausible assumptions about behavior, individuals have incentives to develop institutions for making social choices about income distribution and that it is not unreasonable to assume that these choices reflect individual preferences. The article also attempts to provide a more pragmatic interpretation of the term social welfare function. The paper shows that if income distribution, chosen by individuals acting through some kind of political mechanism, can be assumed to be most preferred, this implies the existence of a social welfare function which has been maximized. If enough is known about the conditions under which this choice is made, the shape of this implied social welfare function can be determined. (Murphy-Rutgers)
W70-10201

DATA, RESEARCH, AND GOVERNMENT,
Yale Univ., New Haven, Conn.
Guy H. Orcutt.
American Economic Review, Vol LX, No 2, p 132-137, May 1970.

Descriptors: *Research and development, *Data collection, *Government, Population, Economic evaluation, Financing, Planning, Statistics, decision-making, Pollution, Computers.
Identifiers: *Economic research, *Social experimentation, *Institutional developments, Research institutes, Program evaluation.

How the federal government, foundations, and others can best aid the devleopment of more potent, social-problem and policy-orientated research is discussed. It should therefore be of value to those interested in increasing the quality and quantity of water resource economics research. The author favors real and relevant social experimentation and less of a dependence on government data collection for securing essential empirical evidence. Institutional developments are needed if essential collection of evidence i response to research requirements is to b achieved. The paper outlines these development and gives the sources from which the resources fo the proposed program would come. The paper con cludes with some general ideas on the financing evaluation and guidance of research programs (Murphy-Rutgers)
W70-10202

P P B IN H E W: SOME MANAGEMENT ISS SUES,
United States Conference of Mayors, Washington D.C.
David R. Seidman.
Journal of the American Institute of Planners, Vo XXXVI, No 3, p 168-178, May 1970.

Descriptors: *Planning, *Budget, *Government *Economic evaluation, Management, Measure ment, Decision-making, Social aspects, Forecast ing, Systems analysis, Financing, Costs, Benefits Program, Risk.
Identifiers: *P P B, *Health Education and Wel fare, Agency conflict, Political difficulties program structure.

Several issues are discussed on the operation of a planning, programming and budgeting (P P B) system. The author anticipates that the insights will prove relevant to the operation of PPB in many agencies. Thus, those in the area of public water resource investments should be aided in evaluating their programs by a reading of this paper. Among the issues covered are those of internal agency con flicts, measurement problems, and political dif ficulties in introducing an innovative management technique into a very complex and often nonquan titative arganizational structure. The program memoranda, program and financial plans, and spe cial analytic studies are discussed in the context of H E W along with some of the problems involved in introducing PPB and developing it into an effective tool for decision-making. (Murphy-Rutgers)
W70-10204

THE CONCEPT OF CAUSALITY IN ECONOMICS,
Illinois Univ., Urbana.
Julian L. Simon.
Kyklos, Vol XXIII, Fasc 2, p 226-254, 1970.

Descriptors: *Economics, *Correlation, Forecasting, Interest rate, Income, Demand, Seasonal, Regression analysis, Time, Costs, Management, Economic evaluation, Decision-making.
Identifiers: *Causality, *Logic, Spurious correlation, Causal direction, Simultaneity, Advertising.

There has been no satisfactory definition of the use of the term causality in economics. No formal definition of causality can be given that will enable an economist to distinguish between those situations that are called 'causal' by most economists. This paper attempts to supply an operational definition of causality that will aid the economist in distinguishing between those cases he wishes to call causal and those he does not. Causal statements are a sub-class of associations and gives an operational definition of causality that tests the following characteristics of an association and its context: (A) predictability; (B) necessary side conditions; (C) spurious causality; (D) examination of how the case fits with economic theory. The potential confusion in many empirical water resource studies, between correlation and causality should make this paper of interest to the water researcher. (Murphy-Rutgers)
W70-10205

PROCEEDINGS AND ANALYSIS, WORKSHOP ON THE PLANNING RESEARCH INTERFACE.
Maine Univ., Bangor. Water Resources Center.

Available from the NTIS as PB-194 565, $3.00 in paper copy, $0.65 in microfiche. University of Maine, 18-19 November 1969, p 88.

Descriptors: *Planning, *Interface, Research and development.
Identifiers: *Research, Water resources information, Workshops, Information exchange.

This workshop was designed to reveal the general nature of the interface dividing researches and planners. Ways were sought to manage, for increased public benefits; the reaction between researchers--as producers of water resources information, and planners--as consumers of that information. It was hypothesized that the information 'reaction' requires acceleration and should probably be reversible so that planners can stimulate the research process more directly. Two general lectures are included: 'A Case Study of the Minnesota Planning and Research Scene' and 'Planning and Problems of Interface'. Three discussion groups have been recorded. They included: 'Public Planning in Maine', 'Research--From Results to Relevance', and 'To What Extent are Research Inadequacies and Planning Failures Correlative.' Also included is a follow-up analysis of the workshops. (Davis-Chicago)
W70-10351

PLANNING AND PROBLEMS OF INTERFACE,
National Water Commission, Arlington, Va.
V. A. Koelzer.
In: Proceedings and Analysis, Workshop on the Planning/Research Interface, University of Maine, 18-19 November 1969, p 17-28. 1 fig.

Descriptors: *Planning, *Interface, Research and development, Institutions, Technology, Communication.
Identifiers: *Research, National water resources management.

Two topics are discussed. First, the tasks of the National Water Commission are outlined. A tentative program of 31 studies has been developed. These studies can be placed in four main categories: (1) studies to delineate future problems and needs; (2) studies to define the objectives of national water resources management, (3) studies to appraise existing institutional arrangements, (4) studies to provide a basis for recommending improvements in institutional arrangements. It is stressed that water resource planning should be recognized as a series of interim solutions rather than a final solution. Second, the problem of interfaces is discussed. Two types of planning interfaces are identified: the interface between research and planning and the interface between technical disciplines in planning. The major difficulty with the first interface is one of communication. Researchers frequently fail to present their knowledge in a form that is understandable to planners. Also there is a reluctance by planners to utilize new techniques that have not been operationalized due to lack of money and time. (See also W70-10351). (David-Chicago)
W70-10352

COMPREHENSIVE FLOOD PLAIN MANAGEMENT,
Office of the Chief of Engineers (Army), Washington, D.C.
George R. Phippen.
Water Resources Bulletin, Vol 6, No 4, p 640-647, July-August 1970. 3 fig, 3 ref.

Descriptors: *Water management (Applied), *Flood control, *Planning, *Flood plains, *Nonstructural alternatives, Flood damage, Cooperation, Open-space.
Identifiers: *Comprehensive flood plain management.

Comprehensive Flood Plain management is the special form of planning and action prompted by flood hazards. Much can be accomplished in the non-Federal sector, but there is also plenty of room for Federal-non-Federal cooperation. Appropriate use of the flood plain requires that hazards be resolved, and that this area function in concert with the larger community. Flood Plain Management objectives are stated in this context. The options for achieving these objectives range from high degrees of flood modification for intense development, as with flood control, to high degrees of susceptibility modification as achieved by public acquisition for open space. Although both forms of options merit consideration in all cases, flood modifying works are more likely to be indicated where a problem already exists, and susceptibility modifying options indicated where timely action can preclude inappropriate decisions. Portions of some flood plains are or will become intensively used or developed--in others, low intensity uses will be appropriate. In the usual case of a problem area the Corps will consider a mixture of current and future uses, and a combination of structural and nonstructural options will be embodied in the solution. (Mariott-Chicago)
W70-10355

THE MULTI-USER ZONE OF THE GULF OF MEXICO--ITS PROMISE AND PROBLEMS,
Texas A and M Univ., College Station.
Richard A. Geyer.
Water Resources Bulletin, Vol 6, No 4, p 580-587, July-August 1970. 5 fig, 2 tab.

Descriptors: *Coasts, *Management, *Gulf of Mexico, *Planning, Recreation demands, Environment, Industries, Jurisdiction, Coordination, Land use, Water utilization, Shore protection.
Identifiers: *Multi-user Zone.

There is an ever increasing intensification of the use of the coastal zone, including lake shores, as the expanding population of the United States moves into this area. Problems of conflicting use between industrial, commercial, recreational, and environmental interests are becoming more frequent. Coastal Zone Management must be concerned with provision of adequate recreational areas, industrial access and environmental preservation. To date effective coastal management has been thwarted by unclear jurisdictions and lack of coordination on the part of local, state and federal agencies. As the result of a two year study by the President's Commission on Marine Engineering and Resources, a number of specific recommendations are made for the Gulf of Mexico. Major recommendations include enactment of coastal management legislation, environmental conservation legislation, full utilization of land and water conservation funds, plans for better coordination between concerned agencies, support of feasibility and engineering studies relevant to the development of offshore industrial facilities, and review of enforcement procedures by federal agencies. Estimated costs of the various facets of the comprehensive plan for coastal management are summarized. (Mariott-Chicago)
W70-10356

AN ANALYSIS OF ALTERNATIVE METHODS OF FINANCING TYPES OF WATER RESOURCES FACILITIES IN MISSISSIPPI,
Mississippi State Univ., State College. Bureau of Business and Economic Research.
J. R. Pulley, and J. L. Roberts, Jr.
Water Resources Bulletin, Vol 6, No 4, p 522-527, July-August 1970.

Descriptors: *Financing, *Municipal water, *Water supply, Economic efficiency, Administration, Water rates.
Identifiers: Central Mississippi, Water Resources Facilities.

The purpose of the study was to investigate and anayze the alternative methods of financing types of water resources facilities used by selected communities in Central Mississippi, and to determine whether the method chosen was most feasible for the community. In the analysis an attempt was made to achieve four objectives: (1) determine the type of water facility needed in relation to use, (2) determine the underlying factors that cause this need, (3) determine the success of the financing method used, (4) determine and analyze any problem areas that arose as a result of the method of financing chosen. Only cities and communities in the process of expanding or constructing water facilities or which had done so during a five year period were studied. Two methods of financing water resource facilities; non-profit Water Associations serving villages and towns, and Municipal Water sources, are discussed in some detail, including a discussion of the problems encountered with each. Principal problems associated with water system financing involve (1) size of municipality, and (2) overall direction of water system programs by competent and efficient administrators. Careful and proper planning is needed to alleviate problems and reach workable solutions. (Mariott-Chicago)
W70-10357

COMPREHENSIVE WATER PLAN, PHASE ONE.
Middlesex County Planning Board, New Brunswick, N.J.

Available from NTIS as PB-188 575, $3.00 in paper copy, $0.65 in microfiche. Comprehensive Master Plan, Part 8, October 1968. 50 p, 2 tab, 6 fig.

Descriptors: *Planning, *Water supply, *Water management (Applied), *Water distribution (Applied), Water sources, Water treatment, Water quality, Regulation, New Jersey, Water utilization.
Identifiers: *Middlesex County (New Jersey), Private on-lot systems, Public systems, Water resources usage.

This report inventories major private, municipal, and regional water supply systems serving Middlesex County Study Area. After a general discussion on nomenclature, private on-lot systems, public systems, and the usage and regulation of regional water resources, each water system is described in terms of its service area function, source of supply, and treatment, transmission and distribution facilities. (See also W70-10362) (Wexman-Chicago)
W70-10361

COMPREHENSIVE WATER PLAN, PHASE ONE: APPENDIX.
Middlesex County Planning Board, New Brunswick, N.J.

Available from NTIS as PB-188 576, $3.00 in paper copy, $0.65 in microfiche. Comprehensive Master Plan, Part TM 11, April 1968, p 45.

Descriptors: *Planning, *Water supply, *Water management (Applied), *Water distribution (Applied), Water quality, Water sources, Financing, Future planning (Projected).
Identifiers: *Middlesex County (New Jersey), Financing structure.

This appendix complements the Comprehensive Water Supply Plan, Phase One. It contains a physical description of all existing water supply facilities in Middlesex County and each of the 26 municipalities in the Study Areas. Service areas, source and capacities, water flow records, financing structure, problem areas and planned future projects are also briefly described. (See also W70-10361) (Wexman-Chicago)
W70-10362

PROCEDURES FOR EVALUATION OF WATER AND RELATED LAND RESOURCE PROJECTS, REPORT TO THE WATER RESOURCES COUNCIL BY THE SPECIAL TASK FORCE.
Water Resources Council, Washington, D.C.

Report, June 1969. 122 p, 1 tab.

Descriptors: *Evaluation, *Water resources, *Land resources, *Planning, Benefits, Costs, Water resources development, Analytic techniques, National income.

Identifiers: *Planning policies, *National objectives, Objectives, Regional development, Environmental enhancement.

This study is a review of present practices in the evaluation of benefits and costs in federal water resource projects together with several recommendations for revisions in current planning policies and practices. A statement of the national objectives for water resource development is presented; included are: national income, regional development, environmental enhancement, and well-being of people. This provides the framework in which the efforts of water and related land projects may be evaluated. For better communication and clearer presentation of information, these effects should be displayed in a system of accounts. Several critical issues that require special technical consideration are discussed. These include measurements of certain national or regional income changes arising from secondary effects, the treatments of costs and in some cases the definition of costs related to the national objective accounts, and formulation of plans in the context of several national objectives. (See also W70-10364 thru W70-10369) (Davis-Chicago)
W70-10363

SECTION I: INTRODUCTION.
Water Resources Council, Washington, D.C.

In: Procedures for Evaluation of Water and Related Land Resources Projects, Washington, D.C.: Water Resources Council, June 1969, p 6-15.

Descriptors: *Water resources, *Evaluation, Federal government, Water policy, Analytic techniques, Water resources development.
Identifiers: Federal policy, Policy.

A short history of the development of federal practices in the evaluation of water resource projects is undertaken. Emphasis is placed upon the development of present federal policy, stressing the increasing range of federal water resource development objectives and constraints placed upon evaluative techniques. Also discussed are some of the major contributions presented at a Water Resources Council hearing in conjunction with the preparation of the document. (See also W70-10363) (Davis-Chicago)
W70-10364

SECTION II: NATIONAL OBJECTIVES.
Water Resources Council, Washington, D.C.

In: Procedures for Evaluation of Water and Related Land Resources Projects, Washington, D.C.: Water Resource Council, June 1969, p 16-25.

Descriptors: *Water resources, *Evaluation, National income, Planning.
Identifiers: *National objectives, *Objectives, Regional development, Environmental enhancement, Well-being of people.

Four national objectives of water resource development are discussed; national income, regional development, environmental enhancement, and well being of people. National income measures the nation's output as the aggregate earnings of labor and property which arise from current and future production and the increase in national income attributable to a project is the measure of its contribution to this objective. Regional development objectives include: increased regional income, increased regional employment, improved regional economic base, improved income distribution, and improved quality of services. Environmental objectives include the conservation, preservation, creation, or restoration of natural, scenic, and cultural resources in order to enhance or maintain the quality of the environment. Well-being objectives consider the personal, group, and community effects of the project or program activity. These provide the framework in which the effects of water and related land projects may be evaluated. The details of these objectives are continually changing as national goals are defined and indeed new objectives might emerge. Comprehensive plans for water and related land resources use and development should be formulated in recognition of their contribution to all of these objectives. (See also W70-10363) (Davis-Chicago)
W70-10365

SECTION III: BENEFIT EVALUATION CONCEPTS.
Water Resources Councils, Washington, D.C.

In: Procedures for Evaluation of Water Related Land Resource Projects, Washington, D.C.: Water Resource Council, June 1969, p 26-53.

Descriptors: *Evaluation, *Benefits, *Costs, *Cost-benefit analysis, Water resources, Measurement, Associated costs, Induced costs, Tangible benefits, Intangible benefits.
Identifiers: Benefit evaluation concepts, Objectives, Primary benefits, Secondary benefits.

A number of basic evaluation concepts are discussed. Emphasis is placed on the evaluation principle that benefits and costs have meaning and can only be identified when directly related to objectives. Further, there is a need to clarify the definition of the specific type of benefits by function and their measurement standards in the context of all objectives and effects for resource development projects. The interpretation and modification of the general benefit definition is concerned with five areas requiring amplification: relation to objectives, identification of all beneficial contributions, measurement of benefit values, the 'with' and 'without' principle, and associated and induced costs. Also discussed were definitions of tangible and intangible benefits, and primary and secondary benefits. (See also W70-10363) (Davis-Chicago)
W70-10366

SECTION IV: NATIONAL OBJECTIVE ACCOUNTS.
Water Resources Council, Washington, D.C.

In: Procedures of Evaluation of Water and Related Land Resource Projects, Washington, D.C.: Water Resource Council, June 1969, p 54-65, 1 tab.

Descriptors: *Evaluation, *Analytic techniques, *Water resources, National income, Decision making.
Identifiers: *System of accounts, *National objective accounts, National objectives, Foregone opportunities.

A system of accounts is recommended that permits the display of the result of planning for any one national objective or any combination of national objectives. Under this system all national objectives are to be stated in quantitative terms to the extent possible, but not necessarily in national income terms. The formulation of comprehensive water resource programs involves two fundamental series of decisions: the choices among objectives and the choices of alternative means to achieve these objectives. The results of analyzing these potentials choices can be ultimately displayed in tables of national objective accounts. These tables include for each alternate plan, an accounting of the benefits and costs for that plan which are appropriate to each of the national objectives. Also included are the opportunities foregone by the adoption of a particular plan compared with each of the other plans. (See also W70-10363) (Davis-Chicago)
W70-10367

SECTION V: PLAN FORMULATION.
Water Resources Council, Washington, D.C.

In: Procedures for Evaluation of Water and Related Land Resource Projects, Washington, D.C.: Water Resource Council, June 1969, p 66-73.

Descriptors: *Evaluation, *Planning, *Water resources, Formulation, Benefits, Optimization, Methodology, Analytic techniques.
Identifiers: *Plan formulation, Objectives, System of accounts.

A number of considerations regarding plan formulation are outlined. First, project plans may be formulated to achieve any specified objectives within the concept of the four major categories of objectives. The evaluation of benefits over time is associated with projections of the needs for goods and services. Water resource planning should always involve adequate representation from the area under study. Optimizing principles used in plan formulation for the national income objective do not serve as well in the plan formulation of the other objectives. Consideration must be given to complementary and supplementary projects and programs which may be involved. A more involved process is encountered with plan formulation with multiple objectives. If a system of accounts is utilized to clearly show the effects and relationship of a project to objectives, the method of optimizing one objective within constraints imposed by other objectives is an acceptable approach to multiple objective formulation. A more complex and difficult method would be to optimize multiple objectives although this approach requires further research. (See also W70-10363) (Davis-Chicago)
W70-10368

SECTION VI: EVALUATION PRACTICES AND MEASUREMENT TECHNIQUES.
Water Resources Council, Washington, D.C.

In: Procedures of Evaluation of Water and Related Land Resource Projects, Washington, D.C.: Water Resource Council, June 1969, p 74-119.

Descriptors: *Evaluation, *Measurement, *Analytic techniques, Costs, Benefits, Alternative costs, National income, Water supply, Irrigation, Water quality, Flood control, Drainage, Recreation.
Identifiers: *Objectives, Land stabilization, Fish and Wild life, Use externalities, Resource immobilities, Regional development, Environmental enhancement, Well-being of people.

Evaluation practices and measurement techniques are discussed for each of the objectives. The use of alternative costs as a measure of benefits is also examined. Within the national income objective a number of primary benefits are analyzed: water supply, irrigation, water quality control, navigation, electric power, flood control and prevention, land stabilization, drainage, recreation, and fish and wild life. Secondary national income benefits are discussed stressing conditions for identification, use externalities and resource immobilities; requirements; and general measurement techniques. The other objectives, regional development objectives, environmental objectives, and well-being objectives are also discussed. (See also W70-10363) (Davis-Chicago)
W70-10369

ESTUARINE CLEAN WATER COST-BENEFIT STUDIES,
International Water Pollution Research Conference (5th).
For primary bibliographic entry see Field 05G.
W70-10373

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE TRUE RATE OF RETURN AND THE REINVESTMENT RATE,
Columbia Univ., New York.
Michael Adler.
The Engineering Economist Vol 15, No 3, p 185-187, Spring 1970.

Descriptors: *Economic evaluation, *Investment, *Capital, *Costs, Profit, Economic life, Optimization, Decision-making, Income, Management, Uncertainty.
Identifiers: *Internal rate of return, *Net present value, *Reinvestment rate, Sinking fund, Depreciation, Profit rate.

It is important, in water resources investments, that there be an accurate assessment of the costs and benefits of alternative projects. It has long been known that the reinvestment rate assumption can cause differences in the ordering of projects ranked by net present value as opposed to internal rate of return calculations. A proposal is examined for reconciling the two methods and shows that the size of the chosen reinvestment rate is relatively unimportant. A common reinvestment rate can be assumed for all projects which can then be ranked according to their true rates of profit. Relatively large errors in the assumed reinvestment rate will be of little concern. (Murphy-Rutgers)
W70-10186

A NOTE ON THE CHOICE OF INTEREST RATES IN COST-BENEFIT ANALYSIS,
London School of Economics and Political Science (England).
A. A. Walters.
Economica Vol XXXVII, No 145, p 78-80, February 1970.

Descriptors: *Discount rate, *Rate of interest, *Economic evaluation, *Cost-benefit analysis, Decision-making, Planning, Optimization, Income, Maximization, Prices, Cost, Government.
Identifiers: *Long-term rate, *Short-term rate, *Programming, *Rate of return, Securities.

Cost-benefit analysis is widely used to evaluate investments in the water resources field. This article deals with the necessary problem of choosing a discount rate when using this method of analysis. There is no accepted opinion on the appropriate interest rate to be used; some analysts prefer the long term rate, others the short rate. The author shows that there is a straight forward theoretical programming solution to the problem. It involves the comparison of the rate return on the investment with an investment in government securities. (Murphy-Rutgers)
W70-10193

AN AGGREGATE HOMOTHETIC PRODUCTION FUNCTION,
Maryland Univ., College Park.
Paul A. Meyer.
The Southern Economic Journal, Vol XXXVI, No 3, p 229-238, January 1970.

Descriptors: *Returns to scale, *Economic efficiency, Costs, Mathematical study, Prices, Total costs, Average cost, Statistics, Regression analysis, Capital, Labor, Correlation, Wages, Income, Economic evaluation.
Identifiers: *Homothetic production function, *Elasticity of substitution, *Cost minimization, Homogeniety, Isoquants.

A homothetic production function is compared with the Cobb-Douglas (C-D) and constant elasticity of substitution (C E S) type of production functions. It is usually assumed, in water utility studies, that constant returns to scale exist and the C-D and C E S production functions are the type most often estimated. This author calls into question the assumptions implied in several production functions concerning returns to scale and the elasticity of substitution. He demonstrates that the assumptions of a homothetic production function are less restrictive than those of the C-D and C E S functions since the latter are a special class of a homothetic function. The author concludes that since the extra cost of estimating a general homothetic function is often quite small, the data rather than a priori assumptions should be allowed to determine the value of important parameters. Thus, this production function may be used to more accurately describe the production relations in the water resources area. (Murphy-Rutgers)
W70-10203

MUNICIPAL UTILITY BOND FINANCING,
Felicity A. Bray.
Journal of the American Water Works Association, Vol 62, No 8, p 468-472, August 1970.

Descriptors: *Financing, *Economics, Planning, Water resources development, Public utilities, Investment, Costs.
Identifiers: *Bond issue, *Revenue bonds, General obligation bonds, Prospectus.

Revenue producing utilities which are municipally owned and run usually depend on interest bearing bonds for the funding of capital improvements. The financial arrangements must correspond to the type of utility and its expected life. Various financial arrangements are discussed. The role of the engineering consultant in estimating the cost and feasibility of capital improvements is discussed. Factors affecting interest rates of bonds are presented. The function of the financial consultant in minimizing interest rates and in the preparation of the bond issue is explained. The provisions and covenants of revenue bonds which make them attractive and safe for the investor are discussed. Pitfalls of revenue bond financing are mentioned, and the importance of good financial counsel in avoiding them is stated. The bond prospectus is a very important document in a sound financing program. The requirements of a good prospectus are enumerated. The effectiveness of the prospectus and a credit rating service in increasing the number of potential investors is demonstrated. (Hewett-Rutgers)
W70-10347

SOME ECONOMIC ASPECTS OF WATER REUSE IN CZECHOSLOVAKIA,
International Water Pollution Research Conference (5th).
For primary bibliographic entry see Field 05D.
W70-10372

6D. Water Demand

LINEAR PROGRAMMING MODELS FOR ESTIMATING THE AGRICULTURAL DEMAND FUNCTION FOR IMPORTED WATER IN THE PECOS RIVER BASIN,
New Mexico Univ., Albuquerque.
Micha Gisser.
Water Resources Research, Vol 6, No 4, p 1025-1032, August 1970. 8 p, 1 fig, 4 tab, 13 ref.

Descriptors: *Water demand, *Inter-basin transfers, Texas, *Mathematical models, *Linear programming, Irrigation water, Water costs, Economics, Sprinkler irrigation, Demand, Parametric hydrology, Water supply, New Mexico.
Identifiers: Agricultural water demand, Pecos River Basin.

Parametric linear programing methods were used to estimate the agricultural demand function for imported water in the Pecos basin. A parametric linear programming model suitable for the Pecos basin was developed. Agricultural activities in which land is irrigated either by local or imported water and by either ditch or sprinkler irrigation were developed and adjusted for forecasted 1980 prices. These agricultural activities were used by the parametric linear programing mode, and various agricultural demand functions were obtained for the Pecos basin. These functions show the expected quantitites of imported irrigation water that would be demanded at different prices and under a variety of constraints. (Knapp-USGS)
W70-10055

A HYDROLOGIC BUDGET FOR A SOUTHERN ALBERTA IRRIGATION DISTRICT,
Department of Agriculture, Lethbridge (Alberta). Research Station; and Alberta Univ., Edmonton. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-10298

WATER RESOURCES PROBLEMS: PRESENT AND FUTURE REQUIREMENTS FOR LIFE,
H. C. Pereira.
In: Use and Conservation of the Biosphere, p 71-85, Unesco, Paris, 1969.

Descriptors: *Hydrologic cycle, *Planning, *Water quality, *Watersheds (Basins), Nuclear energy, Nuclear powerplants, Irrigation effects, Arid lands, Semiarid climates, Tropical regions, Saline water systems, Saline water-freshwater interfaces, Runoff, Precipitation (Atmoshperic), Erosion, Vegetation effects, Groundwater, Surface waters, Rivers, Dams, Evaporation, Water storage.
Identifiers: *World water problems, *Water quantity.

The hydrologic cycle is described as a closed, balanced system characterized by circulating water whose major source and sink are the oceans. The primary equations describing the hydrologic cycle cannot be altered, but equilibria can and are, primarily by man's intervention. Disturbances at any level create perturbations at many other levels, and water projects must therefore be carefully and rationally planned. Man must plan not only in terms of quantity but also the quality of water related to specific needs, and this must be augmented by data collection, technical training and land-use planning concomitant with the hydrologic possibilities of a given area. Problems of vegetation manipulation, surface storage development, groundwater storage and maintenance and improvement of quality are described for a variety of climates and specific areas. Recent alleviating technological innovations are also considered in detail. The special problems of high-rainfall and arid areas are extensively described and it is felt that man's environmental misuse may be measured by soil erosion in arid areas and by water pollution in wet climates. Major conclusions are: (1) River basins, and sometimes groundwater basins are the fundamental units of water resources development; (2) River basin studies should recruit a variety of disciplines--not merely engineers. (Casey-Arizona)
W70-10312

6E. Water Law and Institutions

FUGETT V STATE (CONSTITUTIONALITY OF COMMERCIAL FISHING REGULATION).

188 SW2d 641-643 (Ark 1945).

Descriptors: *Arkansas, *Commercial fishing, *Regulation, *Legislation, Fish conservation, Fish, Fishing, Sport fishing, State governments, Governments, Wildlife, Judicial decisions, Legal aspects, Adjudication procedure, Natural resources, Conservation.
Identifiers: *Constitutionality.

Appellant commercial fisherman was convicted of violating a state law which required commercial fisherman to throw back undersized fish but contained no such restrictions on other fishermen. Appellant contended that the law unconstitutionally discriminated against him since other fishermen could take small fish for their own consumption while he could not because of his occupation. Affirming the conviction, the court held that, since fish and other game are the property of the state, they are subject to state regulation. The wisdom and manner of such regulation is for the legislature, not the courts. If the legislature decides a particular conservation measure is necessary to protect the state's resources, the court will not strike down that measure unless it clearly contravenes the constitution. (Liptak-Florida)
W70-10072

JOHNSON V SOWELL (DAMAGE MEASURE WHERE SAND AND GRAVEL BASIN OVERFLOWS ONTO ADJOINING FARMLAND).

15 So 2d 688-689 (Miss 1944).

Descriptors: *Mississippi, *Overflow, *Damages, *Submergence, Flooding, Farms, Farm ponds, Pastures, Compensation, Judicial decisions, Legal aspects, Sands, Gravels, Leases, Weeds, Mosquitoes, Value, Impoundments, Excavation, Impounded waters.

Defendants, holders of a sand and gravel lease on lands adjacent to plaintiff's farm, impounded waters on the leased land for use in the sand and gravel process. This basin overflowed, submerging an acre and a half of plaintiff's pasture land. In plaintiff's suit for damages, she sought compensation for: (1) the destruction of a small pond on her land; (2) sand and gravel wrongfully taken from her land by defendants; (3) the full value of the submerged land; and (4) mosquito infestation caused by the weeds fringing defendant's intruding impoundment. The lower court awarded plaintiff the total sum of $800, and the Supreme Court of Mississippi affirmed on condition of remittitur. The court noted that full-value recovery could not be had for the submerged land since the land would regain its original value when the gravel operation ultimately ceased. Also, there could be no recovery for mosquito damage since defendants could reasonably impound waters on their premises even though the mosquito population would thereby be increased. The mere fact that the impoundment extended onto plaintiff's land did not make plaintiff more susceptible to mosquito damage than she would have been had the impoundment remained on defendant's land. (Marsee-Florida)
W70-10115

THE LONG COUNT ON DEMPSEY: NO FINAL DECISION IN WATER RIGHT ADJUDICATION,
Montana State Univ., Bozeman. Water Resources Research Center.
Albert W. Stone.
Montana Law Review, Volume 31, No. 1, Fall 1969. 27 p. OWRR Project A-031-MONT (1).

Descriptors: *Water law, *Water rights, Legislation, Montana.
Identifiers: Adjudication, Water code.

This review brings up to date the chronicle of litigation on Dempsey Creek, a small stream of less than twenty miles in length: fourteen lawsuits with eight decisions by the Montana Supreme Court. In nearly every one of these lawsuits, all or substantially all of the people in the community of Dempsey Creek were litigants. There seems little risk in predicting that the past is but a prelude to continuing and endless litigation in the future. This history of unending litigation among neighbors on a small watershed speaks for itself on the futility of Montana's present system of stream adjudication. A complete overhaul of the law was introduced in the last legislative session as part of House Bill No. 337, but failed passage. Such legislation would be a great boon to Montana and to all persons who deserve a secure and definite priority without endless lawsuits.
W70-10124

IN RE GILLESPIE (CITY'S ACQUISITION OF WATER RIGHTS BY CONDEMNATION).

272 NY 18, 3 NE2d 618-620 (1936).

Descriptors: *New York, *Water supply, *Eminent domain, *Riparian rights, Streamflow, Water rights, Public rights, Riparian land, Railroads, Streams, Natural flow doctrine, Flooding, Water injury, Condemnation, Alteration of flow, Legal aspects, Judicial decisions, Water law, Municipal water, Water sources, Cities, Local governments, Tunnels, Legislation.

Plaintiff New York City Board of Water Supply petitioned for condemnation of water rights in a stream appurtenant to defendant railroad's property. Plaintiff sought the right to increase or decrease the normal flow of the stream as necessary for the city's water supply. Defendant contended that the petition was improper since plaintiff failed to comply with state law providing for negotiations with railroads prior to condemnation proceedings. Moreover, any increase in the stream's flow during high water would cause flooding and damage to defendant's land. Reversing a judgment for defendant, the Court of Appeals of New York held that the negotiation statute permitted, but did not compel, plaintiff to negotiate before bringing a condemnation petition. The court further noted that the acquisition of the right to increase or decrease the normal flow of the stream did not contemplate abnormal or flood conditions, and plaintiff could acquire no such right to cause damage to defendant's land. (Liptak-Florida)
W70-10136

STEINLE V CITY OF CINCINNATI (CITY'S LIABILITY FOR SUBSIDENCE DAMAGE CAUSED BY LEAKING SEWERS).
142 Ohio St 550, 53 NE2d 800-803 (1944).

Descriptors: *Ohio, *Subsidence, *Settlement (Structural), *Sewers, Drainage water, Judicial decisions, Adjudication procedure, Legal aspects, Condemnation, Eminent domain, Compensation, Land tenure, Real property, Cities, Municipal water, Local governments, Waste water disposal, Damages, Leakage.

Plaintiff property owner sought damage for a taking of her property resulting from defendant city's negligent maintenance of its sewer system. The alleged negligence had allowed sewage water to escape onto plaintiff's land causing subsidence of plaintiff's house. Plaintiff contended that the intrusion of the water was a temporary appropriation of her property for public use. Defendant argued that plaintiff had purchased the property after the damage had occurred and therefore was not the proper party to bring the action. Affirming a judgment for defendant, the court noted that although plaintiff attempted to introduce an assignment of the claim from the former owner, the evidence did not appear until after plaintiff began her action. Therefore, at the time of the institution of the action, she was not the real party in interest. (Liptak-Florida)
W70-10138

PEOPLE V STATE TAX COMM'N (FRANCHISE ASSESSMENT OF RAILROAD CROSSINGS OVER NAVIGABLE STREAMS).
29 NE2d 932-933 (NY 1940).

Descriptors: *New York, *Railroads, *Bridges, *Assessments, Transportation, Streams, Navigable waters, Ownership of beds, Judicial decisions, Adjudication procedure, Legal aspects, Taxes, Evaluation, State governments, Administrative decisions, Administrative agencies.

Plaintiff railroad sought to review defendant tax commission's franchise assessment of three bridges or trestles which crossed certain creeks. Plaintiff contended that the assessments were illegal because: it owned the submerged bottom under the crossings, the crossings were not over navigable water, and the crossings were less than 250 feet in length. The Court of Appeals of New York affirmed per curiam the lower appellate court's decision in favor of defendant. The lower court had affirmed the assessments on the ground that the creeks were public navigable waters and the crossings were all over 250 feet in length. (Liptak-Florida)
W70-10140

STATE V CITY OF CLEARWATER (MUNICIPAL OPERATION OF YACHT BASIN).
184 So 790-797 (Fla 1938).

Descriptors: *Florida, *Cities, *Docks, *Engineering structures, Piers, Judicial decisions, Legal aspects, Coastal structures, Marinas, Construction, Maintenance, Channels, Breakwaters, City planning, Water resources development, Operation and maintenance.
Identifiers: *Yacht basins.

Petitioner municipality, in an attempt to construct, operate and maintain a yacht basin, passed an ordinance authorizing such activity and then petitioned the court for validation and confirmation of the issue of yacht basin revenue certificates. The state's attorney challenged the authority of petitioner to construct, operate and maintain a yacht basin. The Supreme Court of Florida affirmed a circuit court decision validating the issue of the revenue certificates. The court concluded that the Florida statute authorizing petitioner to construct, maintain and operate wharves, ship channels, breakwaters and other facilities authorized such city to construct, operate and maintain a yacht basin. (Powell-Florida)
W70-10162

SKRMETTA V ALABAMA OYSTER COMM (REGULATION OF OYSTER TAKING TO CONSERVE STATE PROPERTY).

168 So 167-170 (Ala 1936).

Descriptors: *Alabama, *Conservation, *Regulation, *Public benefits, Navigation, Ownership of beds, Legislation, Judicial decisions, Legal aspects, Public rights, Relative rights, State governments, State jurisdiction, Watercourses (Legal), Fish conservation, Wildlife conservation, Adoption of practices, Economics, Preservation, River regulation, Fish management, Inspection, Administrative agencies, Supervisory control (Power).

Defendant oyster commission passed a regulation forbidding the taking of oysters by dredging on all public reefs and state-owned bottoms in Alabama waters. Plaintiff contended the establishment of the commission was an unconstitutional delegation of legislative authority and sought to enjoin the application of the regulation. The court stated that the state owns the absolute property in the oyster beds and oysters in her navigable waters, holding it in trust and for the use of her people, subject only to the paramount right of navigation. The power and duty of the state to protect such interests of the public by regulation is not subject to reasonable debate. The regulation challenged was valid as its purpose was to conserve state property, and the powers and purposes of the oyster commission were sufficiently specific. The judgment denying plaintiff an injunction was affirmed. (Price-Florida)
W70-10164

GREAT LAKES PORTS FACE FORMIDABLE CHALLENGES,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
Harry C. Brockel.
Seaway Review, Vol 1, No 1, p 5-8, 26, Spring 1970. 1 fig.

Descriptors: *Navigation, Ships, Harbors, Canals, Locks, *St. Lawrence Seaway, Great Lakes.
Identifiers: Welland Canal, Lash Ships.

The role of the St. Lawrence Seaway has already begun to change. The new ship building and port technologies, as well as changing economic conditions, have affected the commerce potentialities of the Seaway Corporation. Although both the Canadian and U.S. governments have insisted that the operational costs of the seaway be met by tolls, the U.S. government has not used many of its indirect powers to encourage seaway use. For instance, the Defense Department has avoided the use of lake ports and U.S. rail rate structures discriminate against fresh water gateways. The author concludes that unless lake ports are modernized, they will become primarily ports for gathering ships

which will meet transoceanic container liners at Montreal to transport commerce back and forth to the lake ports. (Holmes-Rutgers)
W70-10176

STATE GAME AND FISH COMMISSION V LOUIS FRITZ CO (REMOVAL OF ROUGH FISH).

193 So 9-18 (Miss 1940).

Descriptors: *Mississippi, *Fish, *Fish management, *Fish conservation, Judicial decisions, Legal aspects, Water conservation, Lakes, Carp, Riparian rights, Water policy, Turtles, Nets, Administrative agencies, Supervisory control (Power), Regulation, Rough fish.
Identifiers: *Non-game fish.

Plaintiff was the owner of more than nine-tenths of the shoreline of an inland, freshwater, non-tidal natural lake. Defendant Game and Fish Commission executed a contract to remove non-game gross fish from said lake. Plaintiff obtained a temporary injunction enjoining defendants from seining the lake and removing such fish. The Supreme Court of Mississippi held that plaintiff was not entitled to recover from defendant or its members the value of the fish taken from the lake. The injunction was allowed to stand since the members of the court were equally divided on that question. Separate opinions of the justices were presented. (Powell-Florida)
W70-10178

WOODBURY V MUNICIPAL COUNCIL OF GLOUCESTER (ARBITRARY REVOCATION OF FISH-TRAP PERMIT).

61 NE2d 647-650 (Mass 1945).

Descriptors: *Massachusetts, *Fishing gear, *Permits, *Regulation, Judicial decisions, Legal aspects, Cities, Local governments, Commercial fishing, Fishing, Nets, Trapping, Governments, Bays, Oceans, Tidal waters, Navigable waters, Federal government.

Plaintiff fisherman sought review of defendant town's revocation of plaintiff's license to maintain a fish trap. Plaintiff contended that the revocation was arbitrary in that defendant's intent was to grant a license to someone else to maintain a trap at the same location. Defendant argued that plaintiff's license was improperly granted since plaintiff's predecessor's license was still outstanding when plaintiff acquired his license. Quashing the town council's revocation order, the court held that even though the right to maintain a structure in navigable waters is merely a revocable privilege, the revocation cannot be based on arbitrary or capricious grounds. Further, the court noted that plaintiff's predecessor had the right to surrender his license before it expired, which he did, making the grant of plaintiff's license perfectly valid. (Liptak-Florida)
W70-10180

DEL BALSO HOLDING CORP V MCKENZIE (RENT AS PREREQUISITE TO EXERCISE OF RIPARIAN RIGHT TO ACCESS BY PIER).
271 NY 313, 3 NE2d 438 (1936).

Descriptors: *New York, *Riparian rights, *Piers, *Permits, Riparian waters, Navigable waters, Banks, Riparian land, Landfills, Public rights, Legal aspects, Ownership of beds, Usufructuary right, Water law, Judicial decisions, Adjudication procedure, Access routes, Right-of-way, Administrative agencies, Regulation, Local governments, Cities, Land tenure, Real property, Rent.

Plaintiff riparian owner applied for a writ of mandamus to compel defendant Commissioner of Docks of New York City to issue a permit for the construction of a pier on a creek. Plaintiff contended that, as a riparian owner, he had a right of access by means of a pier to navigable water fronting his upland. However, defendant sought to collect rent for the erection and maintenance of the pier. Defendant contended that plaintiff was not a riparian owner but that he had illegally filled the land in question, which actually belonged to the city. Consequently, defendant contended that it could charge plaintiff rent to enter the land and build a pier. On plaintiff's appeal, the court noted that each party was correct as to the law pertaining to his own version of the facts. The case was remanded for a determination of the facts. (Liptak-Florida)
W70-10182

IN RE PUBLIC BEACH, BOROUGH OF QUEENS, CITY OF NEW YORK (CONDEMNATION VALUE OF WATERFRONT PROPERTY BURDENED WITH EASEMENT).
269 NY 64, 199 NE 5-10 (1935).

Descriptors: *New York, *Condemnation, *Easements, *Condemnation value, Eminent domain, Beaches, Judicial decisions, Legal aspects, Right-of-way, Cities, Public benefits, Value, Evaluation, Land use, Compensation, Local governments, Governments, Recreation, Swimming, Recreation facilities, Damages.
Identifiers: Servitudes.

Appellee city brought condemnation proceedings to acquire land for the purpose of establishing a public beach or park. The parcel of land involved was a strip of waterfront property owned by the appellant property association. The association owned the waterfront property subject to an easement in favor of all owners of all lots on a designated map to use and enjoy the beach for bathing and other recreation and sport. For the purpose of maintaining the association's property as a private beach, appellant association received membership fees from the property owners. The association appealed a judgment awarding nominal damages in the condemnation proceeding. The Court of Appeals held that the association was entitled to more than nominal damages since ownership and right of beneficial enjoyment were vested in the appellants. The court stated that the ultimate question in condemnation proceedings is not whether land taken is burdened by servitude, but rather the value of land for any use consistent with the burden on it. (Powell-Florida)
W70-10183

NATIONAL CELLULOSE CORP V STATE (STATE'S LIABILITY FOR APPOPRIATION OF PAPER COMPANY'S WATER RIGHTS).

292 NY 438, 55 NE2d 492-496 (1944).

Descriptors: *Damages, *New York, *Appropriation, *Pulp and paper industry, Canals, Dams, Riparian rights, Riparian waters, Riparian land, Natural flow doctrine, Streamflow, Judicial decisions, Legal aspects, Compensation, State governments, Natural streams, Competing uses, Navigable waters, Preferences (Water rights), Hydraulic machinery, Reservoirs, Channel improvement, Locks, Powerplants.

Plaintiff paper products company brought an action against defendant State of New York to recover loss of profits and the cost of converting from water power to electric power. The loss allegedly resulted from defendant's improvement of a dam for use in connection with a barge canal. Plantiff contended that, after the improvements, defendant used more water than it was entitled to, with the result that at various times there was insufficient water flow to operate plaintiff's plant. This caused plaintiff to lose business and to convert its plant to electric power. Defendant argued that the damages should be limited to the value of the water of which plaintiff was deprived. Affirming a judgment for plaintiff, the Court of Appeals of New York held that plaintiff was entitled to recover all elements of damage that necessarily resulted from defendant's interference with plaintiff's riparian rights. (Liptak-Florida)
W70-10211

RYDER V TOWN OF LEXINGTON (CITY'S LIABILITY FOR WATER DAMAGE CAUSED BY DRAINAGE WATER OVERLOAD OF STREAM).
21 NE2d 382-390 (Mass 1939).

Descriptors: *Massachusetts, *Water injury, *Surface drainage, *Drains, Drainage systems, Drainage water, Surface waters, Surface runoff, Streams, Tile drains, Natural flow doctrine, Flood damage, Prescriptive rights, Judicial decisions, Legal aspects, Water law, Riparian land, Culverts, Cities, Local governments, Adjudication procedure, Drainage effects, Riddance (Legal aspects), Excess water (Soils), Outlet works.

Plaintiff landowners brought an action against defendant town to recover for damage to their land. The damage was allegedly caused by defendant's construction of drains which discharged more surface water into a stream than the stream could handle, thereby flooding plaintiff's land and interfering with the natural drainage of the land. Plaintiffs contended that the discharge of water into the creek without any improvement in the creek's capacity, or in the size of the culvert downstream from plaintiff's property, constituted a trespass on their land. Defendant argued that the drains were installed by public officers for whose acts the town could not be liable and that the town had acquired a prescriptive right to flood the property since the flooding had continued for five years. Affirming a judgment for plaintiff, the court held that the officers who supervised the drain construction were acting as the town's agents, for whose actions the defendant could be liable. The court held further that no prescriptive right to inflict damage on another's land arises from the improper maintenance of a drainage system. (Liptak-Florida)
W70-10214

HAMRICK V CITY OF ALBERTVILLE (CITY'S LIABILITY FOR FLOODING CAUSED BY ROAD IMPROVEMENT).
189 So 545 (Ala 1939).

Descriptors: *Alabama, *Cities, *Road construction, *Flooding, Adjudication procedure, Judicial decisions, Roads, Maintenance, Legal aspects.

Complainant sought to enjoin the taking of his land or, in the alternative, to recover damages for trespass to--and flooding of--the land. The flooding was alleged to have resulted from respondent city's straightening of a road. The Supreme Court of Alabama held that the complainant had not met the burden of proof of establishing the acts alleged. Moreover, the weight of the evidence showed that complainant had for a long time acquiesced in the road work, and complainant's land was in reality enhanced in value by the improvements. (Marsee-Florida)
W70-10217

CITY OF SHREVEPORT V CASE (ULTRA VIRES REGULATION OF MOTOR CRAFT ON LAKE)
198 La 702, 4 So 2d 801-804 (1941).

Descriptors: *Louisiana, *Lakes, *Public benefits, *Boating regulations, Cities, Navigable waters, Ownership of beds, Legislation, Local governments, Water demand, Water supply, Water conservation, River regulation, Pollution, Public health, Pollution abatement, Legal aspects, Judicial decisions, Public rights, Relative rights, Water policy, Supervisory control (Power).

Plaintiff city unsuccessfully attempted to prosecute defendant for operating a motor boat on Cross Lake without a muffler in violation of a city ordinance. Defendant contended the city had been granted authority to pass ordinances affecting the lake only for the purpose of protecting the water supply from pollution and contamination. The city

contended that its power over the lake was plenary. The court ruled that the power granted was clearly meant to be limited to protecting the lake from pollution, and not to be construed as a more general police power. Regulations pertaining to the operation of motor boats without mufflers have no relation to the prevention of pollution and contamination. The ordinance in question was therefore void since it was passed without proper authority. The judgment for defendant was affirmed. (Price-Florida)
W70-10285

EX PARTE GUTHRIE (CITY'S CHARTER POWER TO REGULATE FISHING).
2 So 2d 121 (Fla 1941).

Descriptors: *Florida, *Cities, *Supervisory control (Power), *Fishing, Fish conservation, Judicial decisions, Legal aspects, Regulation, Legislation.

The city charter of Sarasota, Florida granted the city--for municipal purposes only--powers over and title to tidewater and other lands, river and bay bottoms, waters, waterways and water bottoms. Under the charter the city sought to regulate fishing within its boundaries. The Supreme Court of Florida hald that the case of Nash v Vaughn, 133 Fla. 499, 182 So 827, was controlling on the question of the city's authority to so regulate. A legislative grant of the power to regulate fishing did not clearly appear from the language of the charter and could not therefore be recognized. The grant of the land and waters in the charter was limited for municipal purposes and no other. (Marsee-Florida)
W70-10287

SKIRIOTES V STATE (CONSTITUTIONALITY OF FLORIDA'S MARINE BOUNDARY).
197 So 736-739 (Fla 1940).

Descriptors: *Florida, *State jurisdiction, *International waters, *Commercial fishing, Legal aspects, Judicial decisions, Political aspects, International law, Treaties, Legislation, Marine animals, Fishing gear.
Identifiers: *Sponge industry, *Marine boundary, Constitutionality.

Subsequent to his criminal prosecution for the illegal taking of sponges in the Gulf of Mexico, petitioner sought certiorari on appeal. Petitioner admitted taking the sponges with illegal diving apparatus in the location described, but asserted that the marine boundary of Florida was fixed by international law at one marine league (three nautical miles) from the shore, and since the offense was committed beyond this limit, Florida was without jurisdiction. The Florida 1885 constitution fixed the marine boundary at three marine leagues (nine nautical miles). Petitioner contended this provision violates the United States Constitution, federal treaties and executive orders. Moreover, petitioner contended that the act of Congress in readmitting Florida to the Union had not constituted an approval of Florida's marine boundary. The Supreme Court of Florida noted that the marine boundaries of other states extended as much as nine leagues from the shore and that these boundaries were approved by Congress in the same manner as Florida's. In denying the writ of certiorari, the court noted that any state has the right to reasonably fix its marine boundary with the approval of Congress and concluded that the long acquiesence by Congress in the boundary fixed by Florida conclusively indicated such congressional approval. (Hart-Florida)
W70-10295

BENSON V CITY OF ANDALUSIA (CONSTITUTIONALITY OF ORDINANCE FOR OPERATION OF CITY SEWAGE SYSTEM).

195 So 443-446 (Ala 1940).

Descriptors: *Alabama, *Sewers, *Legislation, *Cities, Municipal wastes, Public health, Urbanization, Sewage disposal, Judicial decisions, Legal aspects, Taxes, Operating costs, Payment, Regulation, Relative rights.
Identifiers: *Constitutionality.

Defendant city owned a sewer system. Pursuant to its operation, an ordinance was enacted providing for a sewer service charge commensurate with the number of connections served, a fine for failure to pay the charge, and disconnection from the system after 30 days delinquency. Plaintiff sought to have the ordinance declared invalid, contending that it was: (1) arbitrary, unreasonable, and discriminatory; (2) a taking of property without due process; (3) a tax; and (4) a denial of equal protection of the law. Affirming the lower court's decree for defendant, the court found that: (1) the complaint failed to allege facts showing that the ordinance was unreasonable and arbitrary; (2) the sewer system was municipal property and, since plaintiff had no interest therein, disconnection was not a taking without due process; (3) the charges were for special benefits for certain persons so they could not be construed a general tax; and (4) the ordinance was within the police power. (Hart-Florida)
W70-10299

CHAMBERLAIN V BOARD OF COMM'RS (CONSTITUTIONALITY OF PROPOSED BOND ISSUE).

11 So 2d 724-732 (Ala 1943).

Descriptors: *Alabama, *Income, *Debt, *Tunneling, Urbanization, Interest, Tunnel construction, Cities, Underground structures, Loans, Cost repayment, Judicial decisions, Legal aspects, Legislation, Rivers, Navigable rivers, River beds, Ownership of beds, Reservation doctrine, State governments.
Identifiers: *Constitutionality.

Plaintiff Board of Commissioners brought a petition in equity against defendant taxpayers and citizens of Mobile to determine the authority of the city to issue revenue bonds. Plaintiff had constructed a tunnel under the Mobile River by pledging toll revenue to secure a bond issue. The use of the toll revenue was restricted to paying interest and bond capital and tunnel maintenance. Plaintiff proposed to issue more bonds, with the proceeds to be used to redeem the prior bonds and to extend and enlarge the tunnel project. Plaintiff contended that since the new bonds would pledge revenue from the then municipally-owned tunnel, a constitutionally prohibited city debt would be established. However, the court found that since the Mobile River was navigable, the river bed and therefore the tunnel was state property which was controlled by the legislature. Since the city did not own the tunnel, and the legislature had authorized the toll use for only a specific purpose, the court held that the city was only a quasi-trustee for the toll revenue and therefore the bond issue would not create a city debt. The decision of the lower court for defendant was affirmed. (Hart-Florida)
W70-10302

TOWN OF FRISCO CITY V GREEN (CITY'S BURDEN OF PLEADING COMPARATIVE INJURY DOCTRINE WHERE CITY'S SEWER POLLUTES BRANCH FLOWING THROUGH DAIRY).

12 So 2d 409-410 (Ala 1943).

Descriptors: *Alabama, *Adjudication procedure, *Pollution abatement, *Dairy industry, Damages, Sewers, Sewage, Sewage disposal, Sewage effluents, Streams, Pastures, Livestock, Milk, Odor, Wet seasons, Overlfow, Judicial decisions, Legal aspects, Municipal wastes, Relative rights.
Identifiers: *Injunctions, Contamination.

Plaintiff dairyman sued defendant city seeking t
abate a nuisance. Defendant's sewer discharge
into a wet weather branch flowing across plaintiff
dairy pasture, and in times of wet weather, th
branch overflowed, spilling the polluted wate
over plaintiff's pasture. Plaintiff alleged that th
overflow resulted in: (1) foul odors in and aroun
his nearby dwelling, (2) making the waters of th
branch unfit for his herd's consumption, and (3
contaminating the pasture grasses and milk fro
his cows. Defendant relied on the 'comparative in
jury doctrine', contending that plaintiff had not a
alleged facts from which the court coul
reasonably determine whether the granting of th
injunction sought would result in a greater incon
venience or hardship to the city than the plaintif
would suffer by its denial. The lower court over
ruled defendant's demurrer and the Supreme Cou
of Alabama affirmed, holding that 'comparative in
jury' was a defense and placed the burden of proo
on the defendant. Plaintiff had no burden in hi
pleadings of raising or anticipating such defense
(Marsee-Florida)
W70-10303

CITY OF CLANTON V JOHNSON (ABATABLL NUISANCE AS CONSTITUTED BY NEGLIGENT MAINTENANCE OF SEWERAGE SYSTEM).

17 So 2d 669-673 (Ala 1944).

Descriptors: *Alabama, *water pollution controb
*Waste disposal, *Sewage disposal, Judicial deci
sions, Legal aspects, Riparian rights, Water pollu
tion sources, Public health, Drainage, Drainage
systems, Drainage water, Drainage practices
Ditches, Drains, Rain water, Compensation
Damages, Sewers, Sewage, Sewage treatment
Public benefits, Cities, Disposal, Creeks, Wate
pollution effects.

Untreated sewage from defendant city's sewerage
system poured into a creek which traversed plain
tiff's property and caused certain injury thereto
Plaintiff filed a bill in equity against defendant to
recover damages and to abate the negligent main
tenance of such sewerage system, such main
tenance allegedly constituting a private nuisance
Defendant demurred, contending the action was
barred by the statute of limitations since actions
arising out of tort were to be initiated within six
months of the accrual of the cause of action. The
court found that the negligent maintenance of the
sewerage system constituted an abatable nuisance.
A cause of action did not arise until the harmful
consequences occurred, and each occurrence or
recurrence of such damages constituted a separate
cause of action. The assessments in this complaint
were therefore sufficient to make the bill good as
against a general demurrer. The judgment for
plaintiff was affirmed. (Price-Florida)
W70-10330

CITY OF CORAL GABLES V CRANDON (CONSTITUTIONALITY OF STATUTE ESTABLISHING WATER CONSERVATION DISTRICTS).
25 So 2d 1-3 (Fla 1946).

Descriptors: *Florida, *Water conservation,
*Legislation, *Public benefits, Conservation,
Drains, Runoff, Ditches, Water table, Water
supply, Water districts, Water demand, Water con-
sumption (Excludes consumptive use), Water
resources, Water levels, Public health, Public
benefits, Public rights, Economics, Population,
Census, Saline water intrusion, Taxes, Financing.

Plaintiff sought to enjoin the enforcement of a
statute relating to the creation of water conserva-
tion districts in counties having a population of
more than 260,000 according to the last federal
census. Plaintiff contended the statute was enacted
as a general law when it was in fact a local law, that
proper notice had not been given and that the
statute imposed a tax without the authority of law.
The court pointed out that due to excessive runoff,

drainage of fresh water, increased population, lowering of fresh water levels, and the invasion of salt water into areas previously occupied by fresh water, a serious problem had developed concerning a source of fresh water supply. The challenged statute was enacted to reduce the seriousness of the problem. The court said that notice of its passage was not required and that the classification on the basis of population had a proper basis in the subject regulated. The court also rejected plaintiffs' contention of unlawful taxation by citing previous cases. (Price-Florida)
W70-10348

DOUCET V TEXAS CO (RELATIVE RIGHTS OF MINERAL LESSEES AND OYSTER LESSEES).
205 La 312, 17 So 2d 340-349 (1944).

Descriptors: *Louisiana, *Leases, *Oysters, *Oil wastes, Pollution, Effluents, Sponges, Clams, Hydrogen sulfide, Chemical wastes, Gases, Fuels, Diseases, State governments, Legislation, Relative rights, Judicial decisions, Legal aspects, Oil water, Pollutants.

Plaintiff sued defendant corporation in damages for the value of oysters allegedly killed in beds leased by plaintiff from the state as a result of defendants' pollution of the waters over said beds by its oil operations. Defendant denied liability and contended it was operating under a lease from the state and that its operations were conducted under the best conditions and in accord with approved methods. Defendant also contended plaintiff had failed to prove the proximate cause of the death of the oysters. The court said it was never the intention of the legislature to give to mineral lessees the right to operate in such a manner as to pollute the waters in utter disregard for the rights of oyster lessees. Based on expert testimony relating to extensive experimentation as to the cause of death of the oysters, the court concluded the pollution of the waters with oil and other effluents discharged therein by defendant company was the proximate cause of the death of plaintiff's oysters. The judgment in favor of defendant was reversed. (Price-Florida)
W70-10353

ENFORCEMENT LIMITATIONS IN WATER QUALITY CONTROL,
Federal Water Quality Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-10354

THE MULTI-USER ZONE OF THE GULF OF MEXICO--ITS PROMISE AND PROBLEMS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 06B.
W70-10356

ALEXANDER V CITY OF SHREVEPORT (EROSION OF PROPERTY BY WATER FLOWING FROM CITY CULVERT).

205 La 480, 17 So 2d 716-719 (1944).

Descriptors: *Louisiana, *Ditches, *Accelerated erosion, *Diversion, Superimposed drainage, Drainage effects, Drainage practices, Drainage water, Soil conservation, Storm drains, Cities, Urbanization, Culverts, Erosion, Soil erosion, Damages, Judicial decisions, Legal aspects, Adjudication procedure, Cities, Water injury, Drainage programs, Watersheds (Basins), Small watersheds, Natural flow doctrine.

Plaintiff landowner sought injunction to prohibit defendant city from permitting surface water to flow over his land and also sought damages for injury therefrom. Plaintiff owned several lots upon which a small ditch was dug. Water from a municipal culvert draining a 40 acre watershed flowed through this ditch onto plaintiff's land, causing severe erosion. Plaintiff contended that defendant dug the ditch, and that defendant had diverted water over his property. The Supreme Court affirmed the trial court's judgment for defendant, holding that plaintiff had failed to prove either of these contentions. The court also rejected plaintiff's assertion of res ipsa loquitur since defendant did not have exclusive control of plaintiff's property. (Hart-Florida)
W70-10358

EMERY V ORLEANS LEVEE BD (DEDICATION OF STATE PROPERTY VIA ACT AUTHORIZING PROJECT CONSTRUCTION).
207 La 386, 21 So 2d 418-424 (1945).

Descriptors: *Louisiana, *Levees, *Spillways, *Condemnation, Floods, Flood control, Flooding, Floodproofing, Flood protection, Floodwater, Floodways, Legislation, Mississippi River, Condemnation value, Compensation, State governments, Eminent domain, Public benefits.

The state legislature authorized the construction of a spillway for flood protection purposes in 1924 and authorized the taking of certain lands for that purpose. In 1938, after the completion of the spillway, plaintiffs obtained a certificate of redemption from the state which they claimed title to part of the land under the spillway. Defendant levee board contended that since at the time of the act authorizing the building of the project, the land was then owned by the state, it was dedicated thereby for public use. The court held for defendant stating that at the time of the authorization of the spillway construction, the land in dispute was effectively taken out of commerce and thereafter remained in the ownership of the state. (Price-Florida)
W70-10359

EVANS V DUGAN (PRIVATE USE OF STATE-OWNED SHORE).
205 La 398, 17 So2d 562-566 (1944).

Descriptors: *Louisiana, *Relative rights, *Lake shores, *Public benefits, Riparian rights, Riparian waters, Riparian land, Navigable waters, Shores, Lakes, High water mark, Public rights, Spillways, Dams, Impounded waters, State governments, Impoundments, Recreation, Legal aspects, Judicial decisions, Legislation.

Plaintiff owned property fronting on the shore of a lake. The shore was state property and under the control of a state agency. Defendant owned and operated a fishing camp on said shore. Plaintiff sought to have defendant's residence and camp removed as a nuisance, and contended defendant had appropriated state property for his private use. Defendant contended he was granted permission by the state agency in charge to build and operate such camp as it was deemed to be in the best interest of the general public. Based on the evidence in the record, the court found that defendant was not a trespasser and that the camp operated by him in no way constituted a nuisance but rather was a public convenience. Operation of the camp by defendant did not deprive plaintiff of the free use of the lake shore, and he was not hampered in any way in his rights of fishing, boating, landing or traveling on or along the lake shore. Plaintiff had no right to demand the ejectment of defendant from said shore. The judgment for defendant was affirmed. (Price-Florida)
W70-10413

FILTROL CORP V HUGHES (REASONABLE USE OF LAND AFFECTING SURFACE RUNOFF).
23 So 2d 891-892 (Miss 1945).

Descriptors: *Mississippi, *Surface runoff, *Rainwater, *Reasonable use, Judicial decisions, Legal aspects, Water rights, Overland flow, Surface drainage, Surface waters, Topsoil, Mining, Excavation, Earthworks, Excess water (Soils), Gravitational water, Relative rights, Discharge (Water), Damages.

Plaintiff and defendants were adjoining landowners. Surface water naturally flowed from defendants' land onto plaintiff's land. Defendants were engaged in the removal of clay containing bentonite, and rain water collected in the resulting excavation. Defendants discharged such collected surface water in a body which resulted in damage to plaintiff's land. The Supreme Court of Mississippi affirmed the trial court's judgment of damages for plaintiff and determined that although defendants had the right to make reasonable use of their land without liability to the plaintiff for any unavoidable injury caused him as a result of an incident thereto, defendants did not have the right to cause surface water to be collected and discharged in a body onto plaintiff's land so as to abnormally affect such land. (Powell-Florida)
W70-10420

UNITED STATES V MEYER (DISCRETION IN EXERCISE OF EMINENT DOMAIN AND DAMAGE ARISING THEREFROM).
113 F2d 387-398 (7th Cir 1940).

Descriptors: *United States, *Condemnation, *Eminent domain, *Damages, Condemnation value, Easements, Legal aspects, Compensation, Dams, Dam construction, Damsites, Mississippi River, Illinois, Rivers and Harbors Act, Legislation, Subsurface drainage, High water mark, Riparian rights, Relative rights, Governments, Navigation, Boundaries (Property), Judicial decisions, Administration decisions.

In a condemnation action brought by the United States, defendants' land was taken in fee pursuant to a plan to construct a dam on the Mississippi River. Defendants had cross-claimed to prohibit the taking and also to recover for alleged damage to the subsurface drainage of lands not taken. The taking in fee was challenged as unnecessary and as an abuse of discretion by the Secretary of War. The Seventh Circuit Court of Appeals ruled that the Secretary was authorized by Congress to decide the extent of the exercise of eminent domain practices, and unless an abuse of discretion could be proved, the decision was not reviewable. The court further ruled that the alleged damage to the subsurface drainage was not a taking within the meaning of the fifth amendment but was caused by raising the water level to the ordinary high water mark, which was authorized by the power of the government over navigable waters. The taking in fee and the award of the district court were affirmed. (Barker-Florida)
W70-10423

WASHINGTON WATER POWER CO V UNITED STATES (EVALUATION OF RIPARIAN LAND IN CONDEMNATION SUIT BY UNITED STATES).
135 F2d 541-543 (9th Cir 1943).

Descriptors: *Washington, *Compensation, *Condemnation value, *Condemnation, Eminent domain, Federal government, Judicial decisions, Legal aspects, Land tenure, Local governments, Ownership of beds, Preferences (Water rights), Public benefits, Relative rights, Riparian land, Water rights, Watercourses (Legal), Value, Market value, Property values, Appraisals, Assessments, Evaluation, Land appraisals.

Plaintiff United States had condemned certain riparian land belonging to defendant power company, and compensation therefor was established. Defendant contended a greater compensation should be paid as the property was adaptable for power-site purposes. Plaintiff contended that while such a use was possible under some circumstances, it could not here be exercised. The court, in holding for plaintiff, stated that a riparian owner has no property right in the bed of a stream or to the use of

the water or the power inherent therein as against the United States, and therefore such riparian owner may not recover for the potential power-site value of the riparian lands. (Price-Florida)
W70-10424

IN RE EAST RIVER DRIVE (NO TITLE PASSES TO UNDERWATER LANDS RESERVED FOR PUBLIC STREETS).
159 Misc 741, 289 NYS 433-458 (Sup Ct 1936).

Descriptors: *New York, *Grants, *Ownership of beds, *Road construction, Underwater, Cities, Land, Land use, Management, Land development, Roads, Public lands, Construction, Easements, Judicial decisions, Legal aspects, Condemnation, Access routes, Local governments.
Identifiers: *Underwater lands, *Adverse possession (Legal aspects).

Defendant city gave a series of grants of underwater lands to plaintiffs' predecessors in interest. However, defendant reserved the right to use all or part of these underwater lands for public streets. Up to the time of the condemnation proceeding brought by defendant, no streets had been constructed under the terms of the grants. Plaintiffs claimed title to these underwater lands on the ground that the reservation as stipulated in the original grants was never effectuated and was, therefore, meaningless. Plaintiffs also contended that they held title by adverse possession by virtue of an easement of access and egress over such reserved lands. The court denied plaintiffs' claim of title by adverse possession, as plaintiffs' easement could not ripen into fee title by adverse possession. The court found title to be in defendant, and stated that even though streets were never constructed on the underwater lands, according to defendant's right under the terms of the grants, this did not alter the terms of the grants nor nullify the reservation imposed by such grants. (Finman-Florida)
W70-10425

MILLER V UNITED STATES (EVALUATION OF LAND CONDEMNED BY UNITED STATES).
For primary bibliographic entry see Field 04A.
W70-10428

RUSSELL AND CO V PUERTO RICO (IMPAIRMENT OF CONTRACT FOR WATER RIGHTS).

118 F2d 225-231 (1st Cir 1941).

Descriptors: *Puerto Rico, *Contracts, *Taxes, *Irrigation districts, Administrative decisions, Appropriation, Community development, Condemnation, Eminent domain, Judicial decisions, Legal aspects, Legislation, Preferences (Water rights), Public benefits, Relative rights, Riparian land, Riparian rights, Riparian waters, Water transfer, Irrigation, Water rights, Usufructuary right.

Plaintiff Puerto Rico had been authorized by act of the Puerto Rican legislature to construct and maintain an irrigation district using the water of the Jacaguas River. Plaintiff had also been given the authority to condemn the water rights of all users not located within the district. This arrangement was unacceptable to the users, however, because they needed the water to grow their crops. In lieu of purchasing their water rights, plaintiff entered into a contract with defendants in which plaintiff promised to deliver to each of them an amount of water equivalent to their water right in consideration for which defendants would relinquish said water rights. Later the legislature passed a bill taxing all users of irrigation water on a per acre basis, defendants included. When defendants refused to pay, plaintiff brought this action to collect such taxes. The court held that such a tax on defendants constituted an impairment of the obligation of contract by the government. But for the contract, defendants had a right to use the waters of the river for free. They relinquished that right in consideration for the delivery of an equivalent amount of water. The governmental imposition of a tax constituted an additional condition not bargained for. (Clarke-Florida)
W70-10429

UNITED STATES V CHICAGO BURLINGTON AND QUINCY RR (RECOVERY OF DAMAGES PROXIMATELY CAUSED BY DAM CONSTRUCTION).
90 F2d 161-173 (7th Cir 1937).

Descriptors: *United States, *Mississippi River, *Condemnation value, *Dam construction, Dams, Dam design, Damsites, Sediment control, Eminent domain, Right-of-way, Damages, Railroads, Condemnation, Compensation, High water mark, Banks, Rivers, Lakes, Tributaries, Drainage patterns (Geologic), Judicial decisions, Legal aspects.

Plaintiff United States brought action to condemn a tract of land for the construction of a dam on the Mississippi River. Defendant railroad was awarded damages for the loss of its claim of ownership in the tract and was further given an award for damage which would be done to its rights-of-way, road beds, bridges, and embankments which were located above the dam site beyond the boundaries of the condemned tract. The United States appealed claiming that such damage was remote, consequential and speculative, and thus no award could be given. The Seventh Circuit Court of Appeals, affirming the district court's judgment for defendant, ruled that such damage was proximately caused by the construction of the dam. By filing the condemnation action, the United States impliedly promised to pay for the proximate damage to defendant's remaining property beyond the location of the dam. (Barker-Florida)
W70-10430

UNITED STATES V ALASKA'S PACKING CO (PROSECUTION FOR OIL POLLUTION).
84 F2d 444-446 (9th Cir 1936).

Descriptors: *Washington, *Legislation, *Oil, *Water pollution, Water pollution sources, Pollutants, Oil wastes, Oily water, Ships, Navigable waters, Lakes, Admiralty, United States, Federal government, Judicial decisions, Legal aspects, Regulation, Adjudication procedure.
Identifiers: *Oil pollution.

Plaintiff United States brought libel against defendant vessel for discharge of oil into navigable waters. Defendant contended that the wording of the statute on which the libel was based, ' (i)t shall not be lawful. . .to discharge. . .refuse matter of any kind or description whatever. . .into navigable water,' did not prohibit oil pollution. This contention was supported by the legislative history of a different act, the Oil Pollution Act. Rejecting the proposition that the legislative history of a different act than the statute in question might reveal congressional intent, the court held that the prohibition included the discharge of oil, and reversed the judgment of the lower court for defendant. (Hart-Florida)
W70-10438

REAMS V CITY OF LONDON (SUIT FOR DAMAGES TO PROPERTY CAUSED BY POLLUTION OF A STREAM).

293 Ky 473, 168 SW2d 994-996 (1943).

Descriptors: *Kentucky, *Water pollution, *Sewage effluents, *Treatment facilities, Structures, Cities, Water pollution sources, Water pollution effects, Land use, Damages, Legal aspects, Sewage disposal, Land tenure, Adjuciation procedure, Remedies, Judicial decisions.

Plaintiff sought damages for the pollution of a stream flowing through his property. The damage was allegedly caused by a malfunction of the defendant city's sewage treatment plant. Plaintiff alleged that the damage was caused by the construction o
a permanent structure, and that he should be abl
to collect past and future damages in one action
The city denied these allegations, and furthe
claimed that the pollution existed when the plaintif
purchased the property in question. At trail, th
jury had rendered a verdict for the defendant. Th
court held that the verdict had been based either o
the proposition that the city had not caused the pol
lution, or that the condition existed when plaintif
bought the land. As there was evidence presente
which could sustain either finding, the trial court'
verdict was sustained. (Caldwell-Florida)
W70-10439

**STONE V CITY OF ASHLAND (CITY'S LIA-
BILITY FOR WATER POLLUTION FROM MU-
NICIPAL SEWERS).**
32 NE2d 560-561 (Ohio Ct App 1939).

Descriptors: *Ohio, *Water pollution, *Cities,
*Sewers, Municipal wastes, Natural streams,
Streams, Pollutants, Effluents, Oilywater, Sewage,
Sewage effluents, Local governments, Judicial
decisions, Legal aspects, Water law, Drainage
water, Runoff, Drains, Sewage disposal, Adjudica-
tion procedure, Remedies, Compensation,
Damages.

Plaintiff landowner brought an action against de-
fendant city for damages caused by defendant's
maintenance of its drainage and sewer system. De-
fendant's system had polluted the stream running
through the city and onto plaintiff's property.
Plaintiff contended that such maintenance of the
sewers, and the city's permitting others to add to
the pollution of the stream, was a nuisance, for
which defendant was liable. Defendant argued that
the evidence did not establish that the city had pol-
luted the stream and, that in any event, main-
tenance of the sewers was a governmental function
for which there could be no liability. Affirming a
judgment for plaintiff, the court held that, although
the decision to construct a sewer system is a
governmental function, the actual maintenance
and operation of the sewers is a ministerial function
for which a city can be liable. The evidence clearly
supported the jury's verdict. (Liptak-Florida)
W70-10440

**LIVEZEY V TOWN OF BEL AIR (DUTY OF
MUNICIPALITY TO OPERATE ITS SEWAGE
DISPOSAL PLANT IN SUCH A WAY AS NOT
TO CREATE A NUISANCE).**
199 A 838-843 (Md 1938).

Descriptors: *Maryland, *Pollution abatement, *Sewage disposal, *Municipal wastes, Cities, Sewers, Condemnation, Effluents, Fishkill, Organic wastes, Waste disposal, Drainage systems, Drainage programs, Pollution abatement, Pollution identification, Pollutants, Natural flow doctrine, Sanitary engineering, Judicial decisions, Legal aspects.

Plaintiff sought to enjoin defendant city from operating its sewage disposal plant. Defendant had allegedly polluted a stream which ran through plaintiff's land. Two issues were present: did defendant pollute the stream, and was plaintiff entitled to injunctive relief. The court stated that it is the right of every riparian owner to enjoy in its natural state, in flow, quantity and quality, a natural stream running through his property. A municipality, in making its drains and sewers, is not immune from liability of it so constructs or maintains them so as to amount to a nuisance. The court ruled that the evidence was sufficient to sustain a finding that the pollution and resulting damage was caused by defendant's operation of the sewage plant, and that plaintiff was entitled to relief. Where the nuisance operates to destroy health, or impair the enjoyment of property, and no adequate remedy at law exists, injunctive relief must be granted. However, the court applied the doctrine ofalancing of equities due to the grave hardship and opportunity for disease the immediate shutdown of the disposal plant

would create, and defendant was given a reasonable time to rectify the situation. Such correction not appearing, plaintiff could reinstitute his bill. The trial court's decree for defendant was reversed. (Price-Florida)
W70-10441

THE PANAM (LIBEL FOR THE DISCHARGE OF OIL INTO COASTAL NAVIGABLE WATERS).
54 F Supp 461-462 (D NJ 1944).

Descriptors: *New Jersey, *United States, *Water pollution sources, *Oil, Water pollution, Coasts, Ships, Storms, Navigable waters, Judicial decisions, Legal aspects, Admiralty, Water pollution control, Oil wastes, Oily water, Federal jurisdiction.
Identifiers: *Oil Pollution Act.

A libel action was brought against the oil tanker Panam for the discharge of oil into the coastal navigable waters of the United States. The Panam left Curacao bound for New York carrying a cargo of oil. Before departure the ship had been thoroughly inspected and had received two certificates of seaworthiness. Due to the continuous pounding of the seas as a result of a storm encountered en route, the rivets below the water line were sprung and began to leak oil into the water. The court held that libellant was not entitled to recover in this action because the discharge of oil upon the coastal, navigable waters was involuntary and accidental, and was caused by the abnormal or unusual pressure or strain upon the vessel as a result of the encountered storm. The discharge of oil was deemed an unavoidable accident, and was therefore not a violation of the Oil Pollution Act. (Barnett-Florida)
W70-10442

TRUSTEES OF INTERNAL IMPROVEMENT FUND V STARK (ACTION OF EJECTMENT TO RECOVER ARTIFICIALLY MADE STRIP OF COASTAL LANDS).

25 F Supp 730-732 (SD Fla 1938).

Descriptors: *Florida, *United States, *Riparian rights, *Spoil banks, Rivers, Navigable waters, Dredging, Channels, Channeling, Bays, Administration, Administrative agencies, Legal aspects, Judicial decisions, Boundary disputes, Shore protection, Coasts, Excavation, Civil engineering, Tidal waters, Islands, Riparian land, River beds, River training.

Plaintiffs, Trustees of the Internal Improvement Fund, sought to recover a small strip of land running parallel to the shoreline of the upland which was owned by defendants. This land was connected to the mainland at one end by a narrow neck and otherwise was separated from the mainland by navigable waters, thus creating a peninsula. There was no physical connection between defendant's mainland property and the peninsula. The land in question was created by the United States' dredging a channel and depositing the spoil in the shallow portion of the river. Defendants moved onto the parcel but had no record title to the peninsula. They claimed the land as against plaintiffs solely as owners with riparian rights of the neighboring upland. Plaintiff acquired the land pursuant to statutory provisions in a manner found by the court to be fully in compliance therewith. Upon the strength of this title, the court held that plaintiffs were entitled to have defendants ousted from the land. (Barnett-Florida)
W70-10443

SHUSTER V CITY OF CHISHOLM (LIABILITY FOR POLLUTION OF STREAM).
282 NW 135-136 (Minn 1938).

Descriptors: *Water pollution, *Minnesota, *Municipal wastes, *Sewage effluents, Water pollution sources, Sewage, Riparian land, Riparian rights, Riparian waters, Cities, Local governments, Sewage disposal, Waste water (Pollution), Judicial decisions, Legal aspects, Streams.

Plaintiff brought action against defendant city for damages which resulted from defendant's pollution by the discharge of sewage into a river which flowed by their farm. The court concluded that even though evidence showed another town also contributed sewage to the river, defendant and the other town were independent, not joint, tortfeasors. Evidence showed that defendant's sewage substantially contributed to the nuisance and was a proximate and contributing cause of plaintiff's damage. The lower court's judgment for plaintiff was affirmed. (Morris-Florida)
W70-10444

NELSON V TOWN OF NORTHUMBERLAND (TOWN'S RESPONSIBILITY TO MAINTAIN SEWERS PROPERLY).
5 A2d 39-40 (NH 1939).

Descriptors: *New Hampshire, *Sewage disposal, *Sewers, *Damages, Sewage, Sewage effluents, Cities, Legal aspects, Judicial decisions, Surface drainage, Surface runoff, Surface waters, Conduits, Construction costs, Drainage systems.

Plaintiff landowner brought action against defendant town for the alleged improper construction and maintenance of defendant's sewer. Plaintiff sought damages for injury to her property caused by the overflow of said sewer. Defendant contended that plaintiff had failed to establish the requisite causal connection between the alleged deficiencies in defendant's sewer and the damage suffered by plaintiff. From a judgment for plaintiff, defendant appealed. Defendant's appeal was based on its exception to the charge of the trial court to the jury that plaintiff was entitled to recover if the sewer was not sufficient to take care of the sewerage and surface water. The Supreme Court of New Hampshire held that the charge was erroneous and constituted reversible error. The court also ruled that the proper measure of damages would be either the cost that plaintiff originally incurred when connecting with defendant's sewer or the cost of constructing her private sewerage disposal plant. A new trial was ordered. (Price-Florida)
W70-10445

CAMDEN SEWER CO V MAYOR AND COUNCIL (USE OF SEWERS IN SURFACE WATER DRAINAGE).
185 A 126-129 (Md 1936).

Descriptors: *Maryland, *Local governments, *Sewers, *Surface drainage, Excess water (Soils), Community development, Contracts, Drainage, Judicial decisions, Legal aspects, Legislation, Natural flow doctrine, Overlying proprietor, Relative rights, Public rights, Water transfer, Drainage systems, Storm drains, Sewage disposal, Surface runoff.

Defendants mayor and city council granted plaintiff sewer company the franchise to lay sewer mains along an avenue and certain lateral streets. The city retained the right to drain surface water into the main sewer as long as it did not interfere with the primary purpose of the sewer. Instead, the city constructed catch basins which drained water into the lateral sewers, and eventually such sewers became choked with debris carried by the surface waters. Plaintiff sued for reimbursement of the expense of removing the obstruction, but received a verdict at trial of only $100. Plaintiff appealed on the grounds that the trial judge had refused to instruct the jury that under the franchise ordinance, defendant had no right to drain surface water into the lateral sewers. The appellate court held that this was a proper and necessary instruction and that plaintiff was injured by the trial judge's refusal to give it. A new trial was granted. (Clarke-Florida)
W70-10446

MIAMI BEACH JOCKEY CLUB V DERN (REVOCATION OF FILL PERMIT IN BISCAYNE BAY).
83 F2d 715-720 (DC Cir 1936).

Descriptors: *Florida, *Navigable waters, *Permits, *Land forming, Land development navigation, Inland waterways, Harbors, Non-navigable waters, Channels, Bays, Inlets (Waterways), Administrative agencies, Administrative decisions, Decision making, Judicial decisions, Legal aspects, Landfills, Regulation, Supervisory control (Power).

Plaintiff jockey club sought an injunction to prevent defendant Secretary of War from interfering with a bulkhead and fill project in Biscayne Bay. Plaintiff obtained a fill permit from defendant which was later revoked after protests by local landowners. Plaintiff contended that: (1) since Biscayne Bay was nonnavigable, defendant had no authority over the project; (2) defendant had no power to revoke the permit once granted; and (3) the revocation was arbitrary. The court stated that the bay was navigable in law if navigable in fact, adding that waters susceptible to use as a highway are navigable in fact. Because of its use in international shipping and its navigational channels authorized by Congress, the court held that the bay was navigable. Finding that defendant was authorized to revoke the permit, which was a mere license, and that the revocation was not arbitrary, the court denied the injunction sought by plaintiff. (Hart-Florida)
W70-10447

DE ROCHE V OSBORNE (POLLUTED WATER EVEN WITHOUT CONTAMINATED CLAMS JUSTIFIES CLOSING CLAM BEDS TO COMMERCIAL DIGGING).
37 NYS2d 348-351 (Sup Ct 1942).

Descriptors: *New York, *Clams, *Public health, *Commercial fishing, Conservation, Administrative agencies, Judicial decisions, Legal aspects, Regulation, Public benefits, State governments, Local governments, Cities, Water pollution, Social aspects, Commercial shellfish, Administrative decisions, Remedies.

Petitioner clam digger instituted a proceeding against New York defendants, Conservation Commission and Board of Health, to rescind defendants' order and resolution prohibiting the digging of hard clams in certain New York bays. Petitioner contended the order was unreasonable because New Jersey had not closed clam beds in portions of the same bays under its jurisdiction, and the clams dug therefrom were being sold in New York markets. Petitioner also argued that the report on the public health aspects of clamming in the bays failed to show a single contaminated clam. The Supreme Court of Richmond County, New York denied petitioners' application upon a showing that before the hearing New Jersey had taken the same action as defendants. The court affirmed the defendants' authority to certify those lands from which shellfish may be taken for use as food and to gulate all health matters. The court stated that where it was found that waters in which clam beds were located were polluted, defendants were justified in closing clam beds to commercial digging without waiting until clams themselves had become contaminated. (Powell-Florida)
W70-10448

BOARD OF SUP'RS V FRISBEE (CONDEMNATION VALUE OF PUBLIC EASEMENTS).
18 NYS2d 668-670 (Sup Ct 1940).

Descriptors: *New York, *Condemnation value, *Easements, *Local governments, Condemnation, Compensation, Access routes, Shores, Shore protection, Lakes shores, Lake Ontario, Coastal structures, Project purposes, Docks, Adjudication procedure, Judicial decisions, Legal aspects, Piers.

In a condemnation proceeding, a county sought to acquire title to certain property held as an easement in common by all the citizens of a city. The county commissioners determined that the easements were valueless, and defendants objected. The appropriated land was to be used as a site for wharves for the protection of the shoreline. The Supreme Court of Monroe County held that the easements had already become public in nature, so defendants lost nothing in the condemnation. The condemnation was, however, termed a technical taking and nominal damages were awarded. (Barker-Florida)
W70-10449

ALOTTO V CITY OF CORNING (CAUSE OF ACTION FOR CONTINUING WATER DAMAGE).
258 App Div 932, 16 NYS 575-576 (1939).

Descriptors: *New York, *Sewers, *Water injury, *Jurisdiction, Overflow, Local governments, Cities, Municipal wastes, Sewage, Sewage disposal, Legal aspects, Judicial decisions, Structures, Disposal, Administration, Management, Roads, Road construction, Remedies.

Plaintiff landowner brought action for damages allegedly caused by overflow from defendant city's sewers. Plaintiff contended that the sewers became inadequate to dispose of water and noxious materials as a result of a change in grade of defendant's street. The lower court dismissed the complaint as not stating a cause of action. The Supreme Court of New York reversed. A court of equity will recognize a cause of action to restrain a continuing invasion of property rights and will retain jurisdiction for determination of past damages. (Dye-Florida)
W70-10450

MORETTI V VILLAGE OF PEEKSKILL (DIVERSION OF STREAMFLOW).
12 NYS2d 687 (App Div 1939).

Descriptors: *New York, *Streamflow, *Natural flow, *Alteration of flow, Judicial decisions, Streams, Diversion, Floods, Surface runoff, Lakes, Surface waters, Watersheds (Basins), Flood damage, Local governments, Damages, Overflow, Running waters, Water injury, Legal aspects, Small watersheds, Snow, Snowmelt, Snow management, Melt water.

Plaintiff brought action against defendant village for damages to his house caused by the overflow of a stream running through his property. Plaintiff contended that defendant diverted the waters of a lake from their natural course and deposited them in the stream running through plaintiff's property, knowing that there was no sufficient outlet for such extra water. Plaintiff also contended that defendant deposited a large quantity of snow in the area surrounding plaintiff's stream, causing it to overflow. The Supreme Court of New York reversed the trial court's judgment for plaintiff. Plaintiff's own evidence showed that the lake from which the water was diverted was within the drainage area of the stream running through plaintiff's property. Diversion of the waters of the lake would thus have little effect on plaintiff's stream. (Dye-Florida)
W70-10451

SQUAW ISLAND FREIGHT TERMINAL CO V CITY OF BUFFALO (DAMAGES FOR SUBMERGED SAND INJURY).
256 App Div 582, 11 NYS2d 459-462 (1939).

Descriptors: *New York, *Damages, *Water pollution effects, *Dredging, Water pollution, Pollution abatement, Riparian rights, Soil contamination effects, Wastes, Fouling, Judicial decisions, Islands, Legal aspects, Bays, Erosion, Cities, Local government, Beds, Rivers, Navigable waters, Beds under water, Adjudication procedure.

Plaintiff owned an island in a navigable river and had, through dredging performed by a licensee, created a substantial bay or cove thereon. Defendant city deposited sewage in the river, thereby decreasing the value of the island and damaging the sand on the bed of the cove. Plaintiff sought damages and injunctive relief. Plaintiff contended that his damages should include the decreased value of the submerged sand and gravel and submitted evidence proving the amount of sand damaged and its value. The trial court awarded plaintiff damages for the decreased rental value of the island and the value of the ruined sand. On appeal defendant contended that plaintiff's lack of a license to dredge from the river rendered the sand valueless to plaintiff for purposes of sale. The Supreme Court of New York agreed, holding that plaintiff had the burden of proving a right to dredge sand before he was entitled to damages for injury thereto. Damages were awarded for decreased rental value alone. (Dye-Florida)
W70-10452

ROBINS ISLAND CLAM CO V GAFFGA (PROPERTY INTEREST IN CLAMS).
170 Misc 362, 8 NYS2d 969-970 (1938).

Descriptors: *New York, *Fisheries, *Clams, *Commercial shellfish, Oysters, Shellfish, Storms, Legal aspects, Judicial decisions, Hurricanes, Damages, Winds, Public rights, Commercial fishing, Fish harvest, Marine fisheries, Migration, Relative rights, Public rights, Public lands.

Plaintiff clam company planted clams on its property. Evidence indicated that the clams were removed from plaintiff's property by a severe storm. Plaintiff sought to restrain defendants from removing clams from property adjacent to plaintiff's land. Defendant contended that clams found on public lands may be reduced to possession by anyone, and that any property plaintiff may have had in the clams was lost when they were shifted to public lands. The Supreme Court of New York held for plaintiff. Evidence showed that for a significant period no clams had been found on the land now occupied by the clams in question. Clams are not capable of moving themselves. Thus the clams must have been moved by an act of God. It has been held that at least a qualified right of property may be obtained in oysters. The same is true of clams. Plaintiff was not divested of his property right in the clams by their movement. The court issued a 30-day injunction restraining removal of clams from the area within 150 feet west of plaintiff's property. (Dye-Florida)
W70-10453

IN RE JAMAICA BAY (CONDEMNATION OF SUBMERGED LANDS).
255 App Div 992, 8NYS2d 300 (1938).

Descriptors: *New York, *Beds, *Condemnation, *Condemnation value, Eminent domain, Legal aspects, Real property, Compensation, Judicial decisions, Governments, Local governments, Cities, Administration, Docks, Wharves, Roads.

Petitioner city sought to condemn lands under water which defendants claimed to own. The lower court found that title to the lands was in defendants and set the award. Both parties appealed. The Supreme Court of New York affirmed without comment. (Dye-Florida)
W70-10454

CITY OF NEW YORK V SWIFT AND CO (RIPARIAN RIGHT OF ACCESS TO WATER NOT SUBJECT TO RENT BY CITY OWNING RIVER BOTTOM).
162 Misc 561, 294 NYS 209-211 (1936).

Descriptors: *New York, *Riparian rights, *Access routes, *Rent, Cities, Local governments, Riparian land, Riparian waters, Navigable waters, Right-of-way, Regulation, Ownership of beds, Navigable rivers, Public rights, Docks, Leases, Compensation, Judicial decisions, Legal aspects, Relative rights.

Plaintiff city brought action against defendant riparian owner to recover the reasonable rental value of submerged land belonging to the city, over which defendant had constructed and maintained a freight platform. Plaintiff contended that it had the absolute right to improve the water front for navigation and therefore was entitled to exact rent from anyone using the waterfront. Defendant argued that, as an upland riparian owner, he had a right of access to the navigable water in front of his land. The court noted that although plaintiff's ownership of the river bottom was conceded, it did not appear that the city was exercising its right of improvement, and defendant's riparian right of access should therefore be respected. The court held that the maintenance of the freight platform was a reasonable exercise of defendant's riparian rights and entered a judgement for defendant. (Liptak-Florida)
W70-10455

ELDRED DRAINAGE AND LEVEE DIST V WILCOXSON (DRAINAGE DISTRICT'S AUTHORITY TO LEVY AN ASSESSMENT TO PAY A JUDGMENT FOR DAMAGES).
365 Ill 249, 6 NE2d 149-152 (1936).

Descriptors: *Illinois, *Drainage districts, *Assessments, *Damages, Drainage systems, Taxes, Local governments, Legislation, Compensation, Real property, Administration, Ditches, Legal aspects, Judicial decisions, Condemnation, Eminent domain, Flood damage, Water injury, Remedies, Administrative agencies.

Plaintiff drainage district sought an assessment against defendant property owners to pay a judgment which had been rendered against plaintiff for flood damage to another property owner's land caused by the construction of a drainage ditch. Defendants objected to the assessment, contending that no assessment could be levied on property which received no benefit from the levy, and that the district had no authority to levy for the payment of a judgment in favor of another property owner. Affirming a judgment for plaintiff, the court held that the statutory restriction of assessments to property subject to benefit from the levy only applied to the original cost of an improvement, not subsequent obligations of the district. The court further noted that since the injured property owner had a constitutional right to compensation, the district must have had the authority to levy for the satisfaction of the judgment because the district had no other means of raising funds. (Liptak-Florida)
W70-10456

GEORGIA POWER CO V FEDERAL POWER COMM'N (LICENSING OF HYDROELECTRIC POWER PLANT).
152 F2d 908-914 (5th Cir 1946).

Descriptors: *Georgia, *Dams, *Federal Power Act, *Hydroelectric plants, Judicial decisions, Legal aspects, Hydroelectric project licensing, Hydroelectric power, Navigable waters, Permits, Rivers, Federal government, Non-navigable waters, Navigable rivers, Power head, Power plants, Reservoirs, Regulation, Administrative agencies, Administrative decisions.

Plaintiff power company proposed to build a hydroelectric power plant at a dam to be built by it on an allegedly non-navigable portion of a Georgia river. Intention of such was filed with the Federal Power Commission in accordance with the Federal Power Act. The Commission held hearings to determine if the construction of the plant would affect commerce on the navigable waters of the United States. The Commission decided that the project would affect interstate commerce and ordered plaintiff to apply for a license in accordance with the terms of the Federal Power Act. Plaintiff

sought reversal of the Commission's order, alleging that the provisions of the Federal Power Act did not apply to projects located on a non-navigable part of a stream. The court, relying on factual testimony of the commercial nature and use of the river and the definition of navigable waters as being those which are susceptible of being used in their ordinary condition (or by the means of artificial aids) as highways for commerce, affirmed the Commission's order requiring plaintiff to comply with and be licensed under the Federal Power Act. (Barnett-Florida)
W70-10457

NIAGARA FALLS POWER CO V FEDERAL POWER COMM'N (DIVERSION OF WATER FROM RIVER BY POWER COMPANY).
137 F2d 787-797 (2nd Cir 1943).

Descriptors: *Hydroelectric power, *Financing, *Diversions, *Administrative agencies, Alteration of flow, Diversion structures, Administrative decisions, Federal jurisdiction, Federal Power Act, Rivers, Treaties, Judicial decisions, Legal aspects, Capital, Jurisdiction.

Plaintiff power company, which operated a hydroelectric project on the Niagara River, sought to set aside orders of the Federal Power Commission reducing plaintiff's capitalization. The court affirmed defendant's orders, noting that any diversion of water from the Niagara River by plaintiff was subject to the authority of the Federal Power Commission. (Hart-Florida)
W70-10458

ALABAMA POWER CO V FEDERAL POWER COMM'N (FEDERAL POWER COMMISSION'S DETERMINATION OF HYDROELECTRIC PROJECT COSTS).
128 F2d 280-296 (DC Cir 1942).

Descriptors: *Alabama, *Hydroelectric power, *Federal Power Act, *Administrative agencies, Federal jurisdiction, Water resources development, Hydroelectric project licensing, Financing, Hydroelectric plants, Capital, Capital costs, Electric power costs, Electric power rates, Expenditures, Financial analysis, Permits, Judicial decisions, Legal aspects, State governments.

Plaintiff power company brought action to set aside orders of defendant commission determining the original cost of plaintiff's hydroelectric project. In a lengthy opinion primarily discussing financing, accounting methods and the authority of defendant to review plaintiff's accounts, the court noted that the privilege of exploiting the water resources of navigable streams is granted only by statute, and may be made subject to conditions appropriate to safeguard the public interest. The court then found that plaintiff, having received its license subject to these statutory limitations, could not avoid the comprehensive and inclusive powers of defendant. The prior judgment for defendant was affirmed. (Hart-Florida)
W70-10459

MAJOR AND CITY COUNCIL OF BALTIMORE V CROWN CORK AND SEAL CO (BOUNDARY LINES IN WATERS OF NAVIGABLE RIVER).
122 F2d 385-393 (4 Cir 1941).

Descriptors: *Maryland, *United States, *Cities, *Riparian rights, Navigable rivers, Docks, Boundaries (Property), Judicial decisions, Legal aspects, Riparian land, Landfills, Ownership of beds, Beds under water, Remedies, Airports, Navigable waters, Federal government, State governments, Boundary disputes, Local governments, Regulation.

The harbor engineer for the City of Baltimore, pursuant to state law and city ordinance, drew divisional lines into the waters of the Patapsco River, extending from property owned by the city and an adjoining corporation. These lines were utilized to delineate areas wherein the city and the corporation were entitled to exercise their respective riparian rights. The city airport was erected according to these lines and the corporation was required to adhere to them in erecting improvements on filled land in the river. A controversy arose between the city and the corporation as to the proper location of the division lines. The city wanted to abandon the existing lines and establish new ones, appropriating part of the corporation's lands. The trial court held for plaintiff corporation, finding that defendant city was estopped to deny the original divisional lines as being the proper ones since it had exercised rights otherwise inconsistent with the proposed change. The appellate court affirmed in part and reversed in part, limiting the holding to apply only as to the corporation before the court and not as against other riparian owners whose divisional lines had not yet been determined. (Barnett-Florida)
W70-10460

THE SS NEA HELLIS (VIOLATION OF OIL POLLUTION ACT).
116 F2d 803-806 (2nd Cir 1941).

Descriptors: *United States, *Oily water, *Admiralty, *Water pollution, Legislation, Oil wastes, Federal government, Remedies, Harbors, Oil, Judicial decisions, Legal aspects, Ships, State governments, Navigable waters, Tidal waters, Regulation, Fishing, Rivers and Harbors Act.

The United States brought libel in admiralty against a steamship to collect a penalty for violation of the federal Oil Pollution Act of 1924 for the discharge of oil into the coastal waters of the United States. Exceptions filed to the libel were sustained in the trial court. The court agreed with libelee that no proper allegations were put forth charging a violation of the Act. The Circuit Court of Appeals, Second Circuit, reversed, holding that although insufficient allegations were made to sustain the libel under the Act of 1924, those made were sufficient to charge a violation under the New York Harbor Act of 1888 which forbade the 'discharge of any matter into the tidal waters of the New York Harbor'. In light of a provision in the 1924 act stating that it was in no way to be construed as modifying or repealing any prior act, the court reasoned that there could be no argument that the Act of 1888 was not controlling. The two statutes were found to be complimentary in their effect and provided adequate relief for the violations alleged. (Barnett-Florida)
W70-10461

DOLLAR SS CO V UNITED STATES (DISCHARGE OF REFUSE INTO NAVIGABLE WATERS).
For primary bibliographic entry see Field 05B.
W70-10462

CUNNINGHAM V SKIRIOTES (VALIDITY OF MARINE BOUNDARY EXCEEDING THE INTERNATIONAL LIMIT AS AGAINST A FLORIDA CITIZEN).
101 F2d 635-637 (5th Cir 1939).

Descriptors: *Florida, *International law, *Commercial fishing, *Marine animals, Legislation, International waters, Tidal water, Ownership of beds, Beds under water, Navigation, Navigable waters, Wildlife conservation, Judicial decisions, Legal aspects, State jurisdiction, Jurisdiction, Reservation doctrine, Regulation, Supervisory control (Power).
Identifiers: *Sponges.

Plaintiff sheriff, for the state of Florida, appealed a decision of a federal district court which granted a habeas corpus petition of defendant sponge-diver who was charged with illegally taking sponges with diving apparatus. Defendant contended the jurisdictional limit of Florida is fixed by international law at three miles, and that since he was diving without this limit, Florida had no jurisdiction over him. Plaintiff asserted that the state had jurisdiction to its nine mile marine boundary. Finding that the state owned all tidewater beds within its jurisdiction, subject to the Congressional right to regulate navigation, the court concluded that Florida could regulate sponge-taking. The court agreed that international law fixed Florida's boundary at three miles, but also noted that the Florida limit of nine miles was equally valid as against Florida citizens, and thereby concluded that defendant could not question his own sovereign's boundary. The judgment of the lower court was reversed. (Hart-Florida)
W70-10463

SOUND MARINE AND MACHINE CORP V WESTCHESTER COUNTY (INTERFERENCE WITH NAVIGATION RIGHTS BY SEWER PIPE).

100 F2d 360-363 (2nd Cir 1938).

Descriptors: *New York, *Admiralty, *Pipelines, *Navigation, Riparian rights, Sewers, Pipes, Governments, Local governments, Federal government, Permits, Navigable waters, Channels, Riparian waters, Non-consumptive use, Relative rights, Remedies, Adjudication procedure, Judicial decisions, Jurisdiction, Federal jurisdiction, Legal aspects, Damages.

Plaintiff riparian landowner brought an action in admiralty to enjoin defendant from interfering with plaintiff's right to navigate on waters adjacent to plaintiff's property. Defendant had laid a sewer pipe across a channel adjacent to plaintiff's property and had thus decreased the low water depth, making it impossible for certain craft to use the channel in order to reach plaintiff's boat yard. Defendant argued that it was authorized to lay such pipe by permits from the War Department and the State of New York. The United States Circuit Court of Appeals, Second Circuit, ruled that admiralty jurisdiction was properly sought by the plaintiff since the injury complained of dealt with something intimately associated with the sea and navigation. The court remanded the case to the trial court for determination on the merits, adding that injunction is not a proper admiralty remedy and that the plaintiff should seek damages. (Barker-Florida)
W70-10464

HEID V ALLEGHENY COUNTY (DAMAGES FROM DIVERSION OF SURFACE WATER FLOW BY HIGHWAY IMPROVEMENTS).
122 Pa Super 312, 186 A 215-217 (1936).

Descriptors: *Pennsylvania, *Surface drainage, *Flood damage, *Eminent domain, Drainage water, Drainage, Surface runoff, Overland flow, Damages, Flooding, Highways, Roads, Judicial decisions, Floods, Flow, Natural flow, Drainage effects, Condemnation, Diversion.

In an action for damages, it was established that the state highway department in resurfacing a road had diverted the natural flow of surface water and turned it upon plaintiff's land. Plaintiff contended that the defendant county, as agent for the state, was liable for such damages. Defendant contended that, inasmuch as no actual entry had been made by the highway department upon the land, any damages caused by the improvement of the road were merely consequential and did not require compensation. The court agreed with defendant, holding that the turning of the water upon plaintiff's land was not a direct entry and thus gave rise to only consequential damages. The plaintiff was not entitled to recovery. (Snow-Florida)
W70-10465

IN RE OPINION OF THE JUSTICES (PUBLIC PURPOSE REQUIREMENT FOR CONSTRUCTION OF DAM WITH PUBLIC FUNDS).
190 A 425-431 (NH 1937).

Descriptors: *New Hampshire, *Public benefits, *Electric power, *Project purposes, Dams, Utilities, Structures, Flood control, Electric power industry, Public rights, Governments, State governments, Legal aspects, Judical decisions, Projects, Engineering structures, Financing, Costs, Taxes, Repayment contracts.
Identifiers: *Public purpose.

In an advisory opinion to the governor, the Supreme Court of New Hampshire ruled upon the constitutional validity of an act authorizing the pledge of the state's full faith and credit. The pledge was to guarantee the payment of bonds issued to construct a privately operated dam on the Connecticut River. The court ruled that the act was valid in that the pledge of credit was for a public purpose as required by the constitution. Public purpose was found because electric power and flood control protection would be provided to the people of the area. (Snow-Florida)
W70-10466

LEARY V CITY OF MANCHESTER (PUBLIC PURPOSE REQUIREMENT FOR THE EXERCISE OF THE POWER OF EMINENT DOMAIN).

21 A2d 156-160 (NH 1941).

Descriptors: *New Hampshire, *Condemnation, *Easements, *Project purposes, Ditches, Drainage, Eminent domain, Judicial decisions, Legal aspects, Local governments, Governments, Public rights, Compensation, Maintenance, Maintenance costs.
Identifiers: *Public purpose.

In an action for declaratory judgment to determine whether the defendant municipality could acquire by condemnation the full title to property in which it already had an easement, plaintiff contended that the taking would not be for an authorized public purpose. The defendant, having an easement to build a drainage ditch across plaintiff's land--conditioned upon proper maintenance of the ditch, contended that the expense of such maintenance was greater than the value of the property. Therefore, defendant argued, condemnation should thus be available so as to promote public economy. The court held that public economy was a matter of general welfare and, as such, was a public purpose for which the power of eminent domain could be exercised. Defendant could condemn the land. (Snow-Florida)
W70-10467

UNITED STATES V CERTAIN LANDS IN TOWN OF HIGHLANDS (OWNERSHIP OF POND BED).

52 F Supp 540-550 (SD NY 1943).

Descriptors: *New York, *Ownership of beds, *Boundaries (Property), *Boundary disputes, United States, Condemnation, Land tenure, Real property, Ponds, Beds, Beds under water, Lake beds, Governments, Judicial decisions, Legal aspects, State governments, Non-navigable waters.

In a condemnation suit, the United States sought to acquire land which surrounded a small lake. The issue to be determined by the court was whether title to upland fronting on a non-navigable body of water included title to the land under the water. The State of New York claimed title to the lake by escheat, arguing that the original owners of the upland had failed to specifically mention the title to the pond when the land was transferred. The United States District Court, Southern District of New York, ruled that grants of land surrounding a non-navigable body of water convey ownership of the land under water. Therefore, the state had no claim of ownership in the pond. (Barker-Florida)
W70-10468

LUCAS V CITY OF LOUISIANA (FLOOD DAMAGE CAUSED BY CITY'S NEGLIGENT FAILURE TO REMOVE OBSTRUCTION IN STREAM).
173 SW2d 629-636 (Mo Ct App 1943).

Descriptors: *Missouri, *Overflow, *Obstruction to flow, *Damages, Flood damage, Walls, Banks, Cities, Floods, Land tenure, Bridges, Streams, Legal aspects, Legislation, Construction, Structures, Rainfall, Local governments, Channel flow, Judicial decisions, Drainage, Surface runoff, Flood control, Natural streams.

Defendant city had constructed a stone wall along the banks of a stream flowing through plaintiff's property. The wall later collapsed, blocking the stream, which overflowed after a severe downpour and damaged plaintiff's bridge and other property. Plaintiff presented evidence that the city had negligently constructed the wall, and had negligently allowed it to obstruct the stream flow for some time before the flood. The court held that as the city had adopted the natural watercourse as a drainage outlet, it had a duty to keep the watercourse clear. The fact that no ordinance authorized construction of the statute was held not to obsolve the city from liability. (Caldwell-Florida)
W70-10469

CITY OF LOUISVILLE V COPE (LIABILITY FOR FLOOD DAMAGE CAUSED BY WATER BACKING UP FROM CITY'S STORM DRAIN).
296 Ky 207, 176 SW2d 390-393 (1943).

Descriptors: *Kentucky, *Subsurface drains, *Flood damage, *Backwater, Cities, Obstruction to flow, Floods, Rainfall, Drainage systems, Local governments, Streams, Overflow, Storm drains, Construction, Legal aspects, Judicial decisions, Sewers, Maximum probable flood, Water injury.

Plaintiff landowners brought action for damages against defendant city, claiming that their residences were periodically flooded by backwater from the city's storm drain. The backwater was allegedly caused by a bottleneck in the drain below plaintiffs' lands. Defendant claimed that plaintiffs were quilty of contributory negligence in failing to install backwater valves which would have prevented water from backing up into their residences. The court stated that where a city undertakes to establish drainage and sewer systems, it is under a duty to construct a system adequate to carry off ordinary amounts of rainfall. The fact that the residences were built after the sewer and 'came to the drain' was held not to absolve defendant from liability. Evidence by plaintiffs that backwater valves would not have prevented the damage overcame defendant's contention of contributory negligence, and the lower court's decision for plaintiffs was affirmed. (Caldwell-Florida)
W70-10470

CITY OF PHILADELPHIA V STANDARD OIL CO (RIGHT TO USE OF A BULKHEAD RETAINING WALL).
12 F Supp 647-651 (ED Pa 1934).

Descriptors: *Pennsylvania, *Riparian land, *Bulkheads, *Retaining walls, Low water mark, Riparian rights, Navigation, Docks, Shores, Rivers, Dredging, Ships, Basins, Silting, Judicial decisions, Legal aspects, State governments, River beds, Access routes, Eminent domain.

Defendant was an owner of riparian land within the Philadelphia city limits. Plaintiff city, acting in accord with state law, built a retaining structure along the low water mark in front of defendant's property as part of a 5 mile project to aid navigation. Defendant dredged the river bottom in front of its property to create a ship basin. Plaintiff contended that this basin could not be maintained without the aid of the bulkhead and as a result, defendant was violating a Pennsylvania law which prohibited riparian owners from using such structures for warf purposes without paying the proportionate cost thereof. The court held that the right of free access to navigable water by a riparian landowner includes the right to dredge the channel in front of such land. The city had the right to build the structure as a public improvement, but the Pennsylvania constitution proscribes the assessment of an individual property owner for the cost of improvements for the general public benefit. (Barnett-Florida)
W70-10471

PETRABORG V ZONTELLI (RIPARIAN RIGHT TO USE AND ENJOYMENT OF ENTIRE LAKE).
15 NW2d 174-184 (Minn 1944).

Descriptors: *Minnesota, *Lakes, *Riparian rights, *Riparian land, Recreation, Fishing, Dams, Severance, Boating, Swimming, Drainage systems, Pipelines, Reasonable use, Judicial decisions, Legal aspects, Navigable waters, Lake beds, Boundaries (Property), Mining, Wastes, Relative rights.

Plaintiff riparian landowner brought suit to enjoin the building of a dam and the drainage of a section of a navigable lake by defendant mining company. Plaintiff operated a resort on the western side of the lake, using said lake for boating, hunting, fishing and other recreational purposes in the proper exercise of his riparian rights. Defendant's drainage operations were to take place on the eastern section of the lake. The lake was divided into two sections, connected by a narrow portion of the lake. Defendant argued that this physical attribute of the lake made each section a separate lake, and thus his acts in no way violated plaintiff's riparian rights. Plaintiff argued that defendant's acts were a deprivation of those riparian rights without proper compensation or due process of law. The court affirmed the lower court's issuance of a permanent injunction against defendant, finding that defendant's acts would constitute a trespass and damage plaintiff's riparian rights. The court held that the lake was to be considered one lake, and defendant's acts would have deprived plaintiff of the use of that portion of the lake which all riparian owners were entitled to share equally. (Barnett-Florida)
W70-10472

TESENEER V HENRIETTA MILLS CO (RIGHT TO RECOVER PERMANENT DAMAGES FOR NEGLIGENT OPERATION DAM).
209 NC 615, 184 SE 535-540 (1936).

Descriptors: *North Carolina, *Deposition (Sediments), *Dams, *Streambeds, Damages, Beds, Land, Sands, Silts, Legal aspects, Judicial decisions, Real property, Operations, Engineering structures, Fertility, Soil properties, Crop production, Water injury, Easements, Flooding, Regulation, Backwater.
Identifiers: Debris.

Plaintiff riparian landowner brought action against defendant corporation for recovery of permanent damages to his land which resulted from the negligent operation of defendant's power dam, which was located about one mile below plaintiff's land. Plaintiff contended that silt, sand and debris were deposited upon twenty acres of fertile river bottom land. He further alleged that these deposits upon his land were caused by the negligent operation of defendant's dam and that such land was no longer suitable for crop production. Defendant dam owner denied such contentions and argued that the operation of its dam had always been proper. The court found plaintiff's allegations were sustained by the evidence and awarded him permanent damages. However, the court also granted defendant dam owner an easement to backwater and deposit silt and sand upon the twenty acres of plaintiff's land for which permanent damages had been granted. (Finman-Florida)
W70-10473

JOHN H HEALD CO V CHESAPEAKE AND O RY (TERMINATION OF LEASE INVOLVING WATER RIGHTS DISCHARGES ALL SUCH RIGHTS).

190 SE 325-328 (Va 1937).

Descriptors: *Virginia, *Canals, *Water users, *Leases, Water supply, Water contracts, Water demand, Railroads, Judicial decisions, Legal aspects, Water rates, Water rights, Public rights, Usufructuary right, Contracts.
Identifiers: Private rights.

Defendant railway company owned a canal which provided water to plaintiff corporation under a lease agreement. Subsequently, defendant agreed to sell its canal properties to a third party upon the condition that all public duties connected with the canal be discharged. Defendant had such public duties discharged in the manner prescribed by law. Furthermore, in conformity with the terms of its lease with plaintiff water user, defendant canal owner served notice of his intention to terminate such lease and discontinue the water supply. Plaintiff sought an injunction restraining defendant from discontinuing the water supply on the ground that plaintiff had a private right to the perpetual and undiminished supply of water at reasonable rates. The court held for defendant canal owner and stated that plaintiff water user had no right to the use of canal water beyond that specified in the lease. (Finman-Florida)
W70-10474

CONNER V JARRETT (BOUNDARY IMPLIED TO RUN TO CENTER OF STREAM).

200 SE 39-46 (W Va 1938).

Descriptors: *West Virginia, *Boundaries (Property), *Boundary disputes, *Real property, Land, Streams, Banks, Non-navigable waters, Judicial decisions, Legal aspects, Relative rights, Standards, Implied benefits, Grants.

Plaintiff brought an action of ejectment against defendant involving a small lot which bordered a stream. Plaintiff's deed called for the boundary line of such lot to run from a given point to a stake on the bank of a non-navigable stream. From that point the line was described to run up the stream by courses and distances, which closely corresponded to the course of the stream. Plaintiff contended that his boundary line should be held to follow the center of the stream. Defendant insisted that plaintiff's boundary line should be determined by the courses and distances called for in the deed. The court held for plaintiff, following the general proposition that where a boundary line ran to a point on a non-navigable stream, such description of the line implied that the line should follow the stream at its center unless the grant clearly excluded such construction. (Finman-Florida)
W70-10475

SOUTHLAND COFFEE CO V CITY OF MACON (LIABILITY FOR DAMAGES RESULTING FROM EXTRAORDINARY RAINFALL).
3 SE2d 739-744 (Ga Ct App 1939).

Descriptors: *Georgia, *Flooding, *Sewers, *Precipitation excess, Rainfall, Drainage systems, Drains, Cities, Damages, Rain, Rainfall intensity, Storms, Winds, Flood damage, Flood control, Obstruction to flow, Drainage water, Abatement, Legal aspects, Judicial decisions, Absorption, Intakes, Rainfall-runoff relationships.

Plaintiff company brought suit against defendant city to recover damages which resulted from the flooding of plaintiff's premises shortly after a severe rainstorm. Plaintiff alleged defendant maintained an inadequate storm sewerage system near his premises which constituted a continuing, abatable nuisance. Furthermore, plaintiff contended that defendant was negligent in failing to take necessary steps to correct the known inadequacy of the system. Defendant claimed that plaintiff's damages resulted from an extraordinary downpour of rain caused by an act of God. The court held for defendant, finding plaintiff's damages to have been caused by an extraordinary rainfall which resulted in the sewerage system being taxed beyond reasonable expectation. The court further found that as a result of the heavy rains and high winds, accumulation of debris in the streets had interfered with the normal process of absorption by intake basins and sewers. (Finman-Florida)
W70-10476

JOHNSTON V CITY OF ATLANTA (MUNICIPALITY NOT LIABLE FOR ERROR OF JUDGMENT IN SEWER SYSTEM PLANNING).
31 SE2d 417-419 (Ga Ct App 1944).

Descriptors: *Georgia, *Disposal, *Sewers, *Drainage systems, Surface waters, Sewage, Cities, Construction, Drainage water, Surface drainage, Judicial decisions, Legal aspects, Channels, Drains, Surface runoff.

Defendant municipality constructed a sewer system pursuant to a general drainage plan. A portion of this system consisted of an opening or an inlet into a sewer through which surface waters flowed. A water-trap or catch basin was constructed on three sides of the sewer opening which guided surface waters into the sewer. Subsequently, defendant eliminated the three-sided catch basin and placed a grate or grill over the sewer opening. Plaintiff contended defendant was negligent in changing the opening into the sewer as the new construction did not adequately channel surface waters to the sewer opening. The court stated that the duties of municipal authorities in adopting a general drainage plan involved the exercise of deliberate judgment and wide discretion. The court found for defendant, and held that a municipality is not liable for an error of judgment on the part of its officials in locating or planning improvements to its general system of drainage sewers. (Finman-Florida)
W70-10477

HASER V ALLEGHENY COUNTY (CONDEMNATION PROCEEDING TO CHANGE LOCATION OF A CREEK BED).
185 A 763-764 (Pa 1936).

Descriptors: *Pennsylvania, *Streambeds, *Diversion, *Eminent domain, Condemnation, Beds, Streams, Routing, Judicial decisions, Highways, Roads, Beds under water, Channels, Overflow, Remedies, Damages, Compensation, Local government, State governments, Legislation, Construction.

In a state highway condemnation proceeding, plaintiff contended that defendant county was liable for damages to his property resulting from a change of the location of a creek bed. When the creek bed was straightened and moved to facilitate the construction of a highway, the bed occupied a considerably larger portion of plaintiff's property than it had prior thereto. Defendant contended that it was immune from suit in that only consequential damages, which do not require compensation, were involved. The court held for plaintiff, stating that the legislation authorizing the construction of the highway specifically made the county liable for damages in such a situation. (Snow-Florida)
W70-10478

JANSKY V CITY OF TWO RIVERS (OWNERSHIP OF LAKE RELICTION).
278 NW 527-533 (Wis 1938).

Descriptors: *Wisconsin, *Accretion (Legal aspects), *Boundaries (Property), *Cities, Lake Michigan, Lakes, Land tenure, Real property, Riparian waters, Riparian rights, Prescriptive rights, Riparian land, Legal aspects, Judicial decisions, Highways, Roads, Boundary disputes.

Plaintiff riparian landowner brought action against defendant city and other riparian owners to quiet title to property created by reliction. Plaintiff owned two lots bordering upon Lake Michigan; defendant city's street terminated at the lake. The lake had receded 425 feet from the original waterline. Plaintiff claimed ownership of the reliction between his lots and the new waterline. Defendant contended that the reliction had been used during the prescriptive period as a public highway, and therefore plaintiff had no riparian ownership. Evidence showed that the street ended at the lake with a stone wall, barricade, and danger sign; the court held this evidence disproved the use of the reliction as a public highway. Finding that plaintiff's title gave him riparian ownership, the court apportioned the reliction between the several owners, including defendant city by drawing a straight line perpendicular to the new shoreline from the intersection of the riparian owners' division lines and the old shoreline. (Hart-Florida)
W70-10479

IN RE BD OF SUPERVISORS (DETERMINATION OF LAKE'S NATURAL WATER LEVEL BY A COURT).
For primary bibliographic entry see Field 02H.
W70-10480

MEYERS V LAFAYETTE CLUB (RIPARIAN OWNER'S RIGHT TO DRAW LAKE WATER FOR SPRINKLING: REASONABLENESS OF USE).
266 NW 861-867 (Minn 1936).

Descriptors: *Minnesota, *Riparian rights, *Reasonable use, *Irrigation water, Navigable waters, Lakes, Riparian land, Water levels, Judicial decisions, Damages, Natural use, Domestic water, Legal aspects, Relative rights, Recreation, Diversion, Consumptive use.

Plaintiff riparian owners sought to enjoin defendant golf club from drawing water from a lake on which defendant was also a riparian owner. Plaintiffs contended that the lake's water level was being diminished by defendant club's use. Defendant contended that its use of the lake water for sprinkling its riparian land was a reasonable domestic use which did not substantially reduce the water level. The Supreme Court of Minnesota held that as long as there was no substantial damage to other riparians or to the public interest, defendant club had the right to make a reasonable use of the lake water for domestic purposes or for proper upkeep of its riparian land. (Quesada-Florida)
W70-10481

LAMPREY V AMERICAN HOIST AND DERRICK CO (TITLE TO ACCRETION).
For primary bibliographic entry see Field 02J.
W70-10482

NICHOLS V CITY OF MORRISTOWN (LIABILITY FOR INJURY DUE TO INADEQUACY OF CREEK TO ACCOMMODATE SURFACE WATER).
For primary bibliographic entry see Field 02E.
W70-10483

MARCHAND V MARCHAND FERRY CO (PUBLIC RIGHTS TO LANDING ON PRIVATE PROPERTY ADJOINING A NAVIGABLE STREAM).
51 D and C 79, 7 Fay L J 37-40 (Pa C P 1944).

Descriptors: *Pennsylvania, *Public rights, *Highways, *Docks, Navigable waters, Navigable rivers, Relative rights, Real property, Riparian rights, Roads, Easements, Right-of-way, Legal aspects, Rivers, Transportation, Access routes, Land tenure.

Plaintiffs owned riverfront property across which ran a public highway ending at the water's edge.

Defendant ferry company had for a long period leased the property from plaintiffs for use as a ferry landing. Defendants refused to pay further rent and were ejected. Defendants sought to open the judgment in ejection on the grounds that the ferry landing was part of a public highway and, as such, was open to use by all. The court disagreed. Although a public highway had been constructed on the banks of a navigable stream, the public acquired only a right to passage over the highway. The use of the landing was an additional servitude for which users were required to compensate the owners of the property. (Dye-Florida)
W70-10484

CIMINELLI V LIBURDI (FLOOD DAMAGE RESULTING FROM GRADE CHANGE BY ADJOINING LANDOWNERS).
47 Lac Jur 31-32 (Pa C.P. 1942).

Descriptors: *Pennsylvania, *Flooding, *Relative rights, *Land use, Real property, Judicial decisions, Channels, Graded, Surface drainage, Surface waters, Runoff, Surface runoff, Reasonable use, Competing uses, Diversions, Land, Drainage, Grading, Adjudication procedure, Riddance (Legal aspects), Diversion, Natural flow.

Plaintiff sought relief from flooding of his property caused by a change in grade of defendant's adjoining property. Defendant contended that plaintiff's bill contained insufficient allegations to support it. The Court of Common Pleas of Lackawanna County sustained the objection, but gave plaintiff leave to amend. Every man has the right to full use of his property. If, through non-negligent use, a landowner's neighbor is harmed, the neighbor has no grounds for relief. However, where a landowner cuts an artificial channel which causes waters to be concentrated and discharged with greater than usual force onto another's land, he is liable. A complaint to be sufficient must allege the cutting of such a channel. (Dye-Florida)
W70-10485

MCNEELY AND PRICE CO V PHILADELPHIA PIERS, INC (CONTROL OVER WHARFAGE TARRIFS).
196 A 846-861 (Pa 1938).

Descriptors: *Pennsylvania, *Docks, *Tariff, *Federal jurisdiction, Regulation, Coastal structures, Piers, Federal government, Judicial decisions, Tidal waters, Relative rights, Administrative agencies, Governments, State governments, State jurisdiction, Assessments, Foreign trade.

Plaintiff, a shipper in foreign commerce, sought to enjoin defendant wharf owners from imposing a fee upon shippers for the privilege of using their wharf. The plaintiff contended that such a fee could not be imposed because such had not been approved by the state's Public Utility Commission. Defendants contended that the Public Utility Commission was without jurisdiction to approve wharfage charges because such regulation was within the sole power of the federal government in the regulation of commerce. The court held that wharfage charges were matters falling within the federal government's commerce power and that Congress had preempted the area by passing legislation to the effect that states were without authority to regulate the same. The court also rejected plaintiff's contention that lands bordering on tide water were subject to the regulation by the states alone. The court ruled that this is the case when commerce is not involved, but when regulation of commerce is involved, then the federal government has plenary power. The injunction was denied. (Snow-Florida)
W70-10486

GARRISON V ENGLE (OWNERSHIP OF SUBMERGED LANDS WHERE HIGH WATER MARK HAS CHANGED).
193 A 820-824 (NJ Ch 1937).

Descriptors: *New Jersey, *High water mark, *Ownership of beds, *Boundaries (Property), Navigable waters, Riparian waters, Riparian land, Riparian rights, Relative rights, Boundary disputes, Shores, Beds, Beds under water, Piers, Bays, Judicial decisions, Fluctuation, Water levels, Water level fluctuations, Tidal waters, Legal aspects.

In an action for injunction, plaintiff, owner of a certain riparian grant of land under the tide waters of the Delaware Bay, sought to stop defendant from erecting a pier which would extend from the defendant's property on the shore out into the bay and upon the submerged lands of plaintiff. Defendant contended that he was the owner of the submerged land which extended from his shore property. Defendant's contention was based upon the fact that he had been deeded property extending to the high water mark of the bay and that over time the high water line advanced upon his property. Defendant asserted that he yet owned to the original mark. The court held that when the high water mark of navigable waters is the boundary of property, such boundary is subject to change as the high water line changes. Defendant's ownership thus extended from the new high water mark and not from the original mark. Consequently plaintiff was the owner of the submerged land upon which the pier was to be constructed, and such ownership entitled plaintiff to have the construction of the pier enjoined. (Snow-Florida)
W70-10487

FREEMAN V CITY OF LAKEMILLS (LIABILITY FOR INJURY CAUSED BY NATURAL PROCESSES).
243 Wis 537, 11 NW2d 181-182 (1943).

Descriptors: *Wisconsin, *Natural flow, *Channel morphology, *Storm runoff, Storm drains, Surface waters, Sewers, Creeks, Seepage, Alteration of flow, Cities, Damages, Judicial decisions, Legal aspects, Obstruction to flow, Outlets, Tile drains, Ditches, Drainage practices, Relative rights, Riparian rights, Riparian land, Flooding, Overflow, Channel flow.

Plaintiff landowner brought action to abate an alleged nuisance and for damages for injury to his property. Plaintiff contended that seepage into his basement was caused by the overflow of a natural watercourse adjacent to his property into which flowed surface water from defendant city's storm sewers. Plaintiff contended further that such action by defendant caused refuse deposition in the creek and caused the bed of the creek to be raised, and that the channel change which resulted from the raising of the bed caused the overflow. Defendant admitted only that it had used the creek for an outlet for its storm water, and contended that the evidence did not support the trial court's judgment for plaintiff. The Supreme Court of Wisconsin held that a city has the same right with reference to surface waters as an individual would have. Cities are not liable to riparian owners for material and water that flows from their streets into surrounding streams. The change in the channel of the creek and the raising of the water was a natural process for which no legal liability could be placed on defendant. The judgment for plaintiff was reversed. (Price-Florida)
W70-10488

SIOUX CITY V BETZ (OWNERSHIP OF BEDS OF NAVIGABLE STREAM).
4 NW2d 872-873 (Iowa 1942).

Descriptors: *Iowa, *Land forming, *Patents, *Ownership of beds, Navigable waters, Missouri River, Accretion (Legal aspects), High water mark, Land tenure, Landfills, Channel morphology, Judicial decisions, Legal aspects, Cities, Real property, Beds under water.

Plaintiff city claimed title to certain lands through a patent from the state. The land was created by defendant's dumping of dirt into a navigable stream over a period of ten years. Defendant claimed the land through adverse possession. The court ruled that defendant had failed to prove the elements of adverse possession, and further that such defense was not available as against the state. The tract of land in question was situated below the high water mark of the river and as the state had title to the bed of the river from the high water mark to the center of the river, title to the land in question passed to plaintiff under the patent. Judgment for plaintiff was affirmed. (Clarke-Florida)
W70-10489

RUPP V KIRK (RIPARIAN OWNER'S TITLE TO ACCRETION).
4 NW2d 264-266 (Iowa 1942).

Descriptors: *Iowa, *Accretion (Legal aspects), *Channel morphology, *Alluvium, Navigable waters, Missouri River, Alluvial channels, Boundaries (Property), Boundary disputes, Sand bars, Chutes, Legal aspects, Judicial decisions, Vegetation, Vegetation growth, Channel erosion, Erosion.

In a riparian owner's suit to quiet title to land along the Missouri River, plaintiff alleged the land belonged to him as accretive land. Defendant claimed the land as an island and by adverse possession. The court rejected defendant's argument as to adverse possession and ruled that the evidence warranted a decree for plaintiff. The river had receded in 1927 and formed the bar in controversy, out from the shore of plaintiff's land, by gradual and imperceptible action of its waters. The land was therefore accretive land and plaintiff had title. Judgment for plaintiff was affirmed. (Price-Florida)
W70-10490

TODD V MURDOCK (RIPARIAN OWNERS' RIGHTS TO FRONTAGE ON NEW RIVER SHORE PROPORTIONATE TO ORIGINAL FRONTAGE).
300 NW 284-286 (Iowa 1941).

Descriptors: *Iowa, *Boundary disputes, *Accretion (Legal aspects), *Riparian land, Navigable waters, Missouri River, Erosion, Meanders, Shores, River flow, Riparian rights, Legal aspects, Judicial decisions, Boundaries (Property), Relative rights.

Plaintiffs sought to quiet title to certain land and to enjoin the construction of a fence thereon. Plaintiffs' lot and lots east thereof were originally bounded on the south by the Missouri River. Due to a southerly change in the course of the river, a considerable amount of land was formed between the lots and the new river bank. Plaintiffs claimed title by adverse possession and through a deed to the accreted lands south of their lots asserting that the boundary lines of the lots should merely be extended in their original direction to the bank. Defendant contended that new boundary lines should be drawn so as to save to save to all lot owners river frontage similar to that originally held. The court rejected plaintiffs' claim based on adverse possession. The court also found that the deed through which plaintiffs claimed was ineffective as to third parties. Landowners can agree as to the division of accreted lands except where rights of third parties would be infringed upon. The court held that defendant was entitled to frontage on the new shore proportionate to his frontage on the old shore. The trial court's decree for defendant was affirmed. (Price-Florida)
W70-10491

LUNDBERG V UNIVERSITY OF NOTRE DAME (APPLICABILITY OF NORTHWEST ORDINANCE TO NON-NAVIGABLE WATERS).
282 NW 70-77 (Wis 1938).

Descriptors: *Wisconsin, *Navigable waters, *Navigation, *Access routes, Legislation, Highways, Transportation, Lakes, Rivers, Navigable rivers, Real property, Judicial decisions, Legal

aspects, Federal government, Mississippi River, Easements, Rightlof-way, Bodies of water.

Plaintiffs owned a summer resort on Tenderfoot Lake. Defendant University owned all the land surrounding nearby Plum Lake, 1400 feet northeast of Tenderfoot Lake, and all the land between the two lakes. Defendant erected a fence across a trail between the two lakes, and plaintiffs sought removal of the fence contending that: (1) the Northwest Ordinance of 1787 prohibited closing of a carrying place which is part of a public highway; and (2) plaintiffs had established an easement of passage between the lakes by prescription. The trial court found for plaintiffs on the first ground, not considering the second. The Supreme Court of Wisconsin reversed. The courts of Wisconsin are bound by the Northwest Ordinance. The ordinance provided for free and open access to navigable waters leading into the Mississippi or St. Lawrence Rivers and to carrying places or portage paths between such waters. The Ordinance applies only to waters found to be navigable and actually used for commerce at the time of the passage of the ordinance. However, the path here in question was not used for commerce in 1787, and defendant was entitled to erect a fence thereon. (Dye-Florida)
W70-10492

IN RE TRIBOROUGH BRIDGE APPROACH (CONDEMNATION OF WATERFRONT PROPERTY).
159 Misc 617, 288 NYS 697-720 (1936).

Descriptors: *New York, *Condemnation, *Cities, *Eminent domain, Riparian rights, Public rights, Wharves, Docks, Legal aspects, Condemnation value, Right-of-way, Compensation, Judicial decisions, High water mark, Low water mark, Bridges, Real property, Beds, Ownership of beds, City planning, Local government, Administration, Navigation.

The City of New York sought to condemn property for construction of a bridge approach. Claimants to one lot contended that property to the low water mark was appurtenant to their upland property. Other claimants sought compensation for destruction of riparian rights appurtenant to a damaged lot at the location of a marginal street. (A marginal street is one used in connection with wharves and for the purpose of commerce. Such a street destroys riparian rights in appurtenant land. A marginal street is not public.) Claimants also sought compensation for a pier built by the city between high a low water mark adjacent to claimant's upland. The court stated that land between the low and high water mark belonged to the city unless specifically granted away. The court said claimants could have obtained title to the pier only if its construction was by a wrongdoer. The city in the instant case owned the property upon which the pier was constructed, thus it was not a wrongdoer. However, claimants were entitled to compensation for the taking of property on which the city had built a marginal street where claimants original grant excepted land to be used for public streets. (Dye-Florida)
W70-10493

ST REGIS PAPER CO V NEW HAMPSHIRE WATER RESOURCES BD (LOGGING SLUICEWAY FOR DAM).
26 A2d 832-842 (NH 1942).

Descriptors: *New Hampshire, *Dams, *Lumbering, *Pulp and paper industry, Access routes, Administrative agencies, State governments, Riparian rights, Navigation, Ownership of beds, Relative rights, Riparian land, Riparian waters, Navigable rivers, Dam construction, Sluices, Bypasses, Judicial decisions, Legal aspects, Public rights, Administrative decisions, Decision making.

Plaintiff paper company sued to require defendant water resources board to provide a means for passage of logs past a dam on a navigable river. Plaintiff claimed the right for passage of logs as a member of the public. However, use of the river for logging had been discontinued prior to construction of the dam. The court stated that public rivers were held in trust for the people, and also that when a stream is capable of public service in its natural state, it is public. Navigability was found to be only one test for useful public service. The court found that: (1) individual citizens were entitled to use public waters in a personal capacity only derivatively from their right as a member of the public, since their rights are unvested, non-property rights; (2) even riparian rights provide no right of action against state control of public water which does not damage private land; and (3) state regulation of the right to use public water included the power to bar use altogether. Reasoning that since logging was discontinued prior to dam construction, defendant had not arbitrarily failed to provide a sluiceway, and furthermore had no duty to provide one, the court gave judgment for defendant. (Hart-Florida)
W70-10494

CULLEY V HOLLIS (RIGHTS OF OWNERS OF LAND ABUTTING NAVIGABLE STREAMS TO ERECT IMPROVEMENTS IN SUCH STREAMS).
25 A2d 196-198 (Md 1942).

Descriptors: *Maryland, *Leases, *Competing uses, *Riparian rights, Relative rights, Navigable waters, Ownership of beds, Oysters, Conservation, Shores, Creeks, Permits, Federal government, State governments, Legislation, Riparian waters, Riparian land, Accretion (Legal aspects), Patents, Structures, Piers, Judicial decisions, Legal aspects, Usufructuary right.

Plaintiff sought to enjoin the construction of a pier by defendant. Plaintiff owned a lease giving him the right to grow and harvest oysters in the bed of a navigable stream. Defendant's land abutted the stream and the pier being constructed from defendant's land into the stream caused considerable damage to plaintiff's oyster bed. Plaintiff claimed his rights through a lease from the state and defendant relied on a state statute which gave proprietors of land bordering on navigable streams the exclusive right to make improvements into the water in front of their land. Piers had been previously determined by case law to be such an improvement as contemplated by the statute. Plaintiff contended he had a property right because of the lease which could not be taken without due process of law. The court ruled that when plaintiff acquired his lease he did so with notice of the above mentioned statute, and that owners of property abutting on the waters in which his lease was located had a right to make improvements from their land into the waters. The judgment for defendant was affirmed. (Price-Florida)
W70-10495

HOOD V CITY OF NASHUA (PRIVATE NUISANCE CAUSED BY IMPROPER MAINTENANCE OF CULVERT).
13 A2d 726-728 (NH 1940).

Descriptors: *New Hampshire, *Culverts, *Surface drainage, *Percolation, Surface runoff, Drainage practices, Damages, Relative rights, Drainage, Drainage effects, Drainage water, Drains, Cities, Legal aspects, Judicial decisions, Impounded waters, Impoundments, Structures, Percolating water, Seepage, Topsoil, Outlets, Subsoil.

Plaintiff landowner brought action for damages to his property which resulted from defendants' negligent maintenance of its drainage system. Water was allowed to collect in large quantities and flow through a culvert maintained by defendant onto land adjacent to plaintiff's land. From there the water would percolate into plaintiff's cellar. Defendant contended that there was a lack of the establishment of the necessary causal connection between the alleged improper maintenance and the injury suffered by plaintiff, that plaintiff had suffered no special damages that would give him the right to initiate such an action and that plaintiff had not given defendant notice of his intent to bring the action. The court ruled that the evidence supported the inference that the maintenance of the culvert caused the injury suffered by plaintiff, that plaintiff was the only one who suffered injury because of the culvert, that the negligent maintenance of the culvert was a private and not a public nuisance and that notice of intent to bring action was not required. The trial court's judgment for plaintiff was affirmed. (Price-Florida)
W70-10496

FIRST NAT'L BANK AND TRUST CO V ZONING BD OF APPEALS (OWNERSHIP OF BEDS OF NAVIGABLE WATERS).
126 Conn 228, 10 A2d 691-696 (1940).

Descriptors: *Connecticut, *Sea walls, *Navigation, *Ownership of beds, Navigable waters, High water mark, Low water mark, Riparian rights, Legislation, Grants, Permits, Right-of-way, Cities, Local governments, Administrative agencies, Administrative decisions, Legal aspects, Judicial decisions, Boundary disputes, Zoning, Public rights.

Plaintiff owned a mainland lot and an island across therefrom. To bring himself within zoning laws, plaintiff contended the two tracts were actually one lot. Plaintiff relied on grants by the state to his predecessors in title permitting the construction of seawalls between the high and low water mark in front of the tracts. Also granted was the right to fill in the space between the walls if such did not impede public navigation. Land thus created was to be the builders of the walls. Plaintiff contended the grants gave him in fee the land below the high water marks and therefore connected the two parcels. The court ruled the land did not belong to plaintiff as no sea walls had been constructed or fill created. The court found the waters between the tracts to be navigable at high tide, and to allow the interpretation contended for by plaintiff would infringe on public rights and rights of other riparian owners. (Price-Florida)
W70-10497

HARZ V BOARD OF COMMERCE AND NAVIGATION (TITLE TO SUBMERGED LAND).
126 NJ Eq 9, 7 A2d 803-808 (1939).

Descriptors: *New Jersey, *Submergence, *Boundary disputes, *Erosion, Waves (Water), Bank erosion, Accretion (Legal aspects), Low water mark, High water mark, Tides, Tidal effects, Tidal waters, Shores, Navigable waters, Leases, Grants, Condemnation, Land tenure, Legislation, Legal aspects, Judicial decisions, Administrative agencies, Overlying proprietor.

Defendant Board of Commerce and Navigation's lot abutted a bay and was located between the bay and plaintiff's lot. Originally the high water mark of the bay was on the lot now claimed by defendant. At the time defendant bought the lot it was submerged at high tide and the high water mark was on plaintiff's lot. Plaintiff sought a riparian lease with an option to buy the lands under the water of the bay in front of his lot. Defendant contended its lot was the upland bordering on the bay and it was entitled to the grant sought. The court stated that when what was once fast land is lost by erosion and is submerged at high tide, title thereto is in the state while it is submerged. A proprietor is subject to loss by erosion without remedy as he is subject to gain by accretion. The court held that plaintiff was the present riparian owner. Injunctive relief was withheld to give defendant a reasonable time to begin condemnation proceedings. (Price-Florida)
W70-10498

LEARY V CITY OF MANCHESTER (LIABILITY FOR NUISANCE CREATED BY FAILURE TO PROPERLY MAINTAIN DRAINAGE DITCH).
6 A2d 760-762 (NH 1939).

Descriptors: *New Hampshire, *Easements, *Ditches, *Drainage, Drainage effects, Drainage practices, Drainage water, Drains, Cities, Surface waters, Relative rights, Legal aspects, Judicial decisions, Water quality control, Water demand, Water levels, Municipal water.

Plaintiff landowner sought to abate an alleged nuisance caused by defendant city's construction and maintenance of a drainage ditch across plaintiff's land. Defendant had been granted an easement across the property for the purpose of draining off surface water which menaced the purity of its water supply. The ditch was to be maintained so as to cause no unreasonable or unnecessary damage to the premises. Defendant failed to maintain the ditch, and the court ruled that the condition which resulted constituted a nuisance from which plaintiff was entitled to relief. (Price-Florida)
W70-10499

ROONEY V MILLSTONE TP (DAMAGES FROM DISCHARGE OF SURFACE WATER DRAINAGE).
121 NJL 624, 3 A2d 580-581 (1939).

Descriptors: *New Jersey, *Drainage water, *Surface waters, *Flood damage, Drainage, Drainage systems, Surface runoff, Surface drainage, Drains, Runoff, Judicial decisions, Highways, Roads, Damages, Flooding, Ponding, Diversion, Routing, Alteration of flow, Diversion structures, Cities, Local governments, Jurisdiction.

In an action for damages, plaintiff contended that defendant municipality, while improving a road, built a catch basin upon plaintiff's property which from time to time overflowed causing damage to plaintiff's property. Defendant contended that it was immune from suit. The court held that a municipality has no right, by artificial drains, to divert surface water from its ordinary course and cast it, in a body large enough to do substantial injury, on land where, but for such artificial drains, it would not naturally go. The liability arising from such action is not to be dismissed due to a municipal corporation's exemption in that an active wrongdoing is involved to which the exemption does not apply. Defendant was thus held liable for the damages done to plaintiff's property as a result of the diversion of surface water. (Snow-Florida)
W70-10500

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, EAST FORK SAN JACINTO RIVER, REESE AND TARKINGTON BAYOUS, CLEVELAND, TEXAS.
Corps of Engineers, Galveston, Tex.
For primary bibliographic entry see Field 04A.
W70-10275

FLOOD PLAIN INFORMATION, PASCAGOULA - GAUTIER COASTAL AREA, JACKSON COUNTY, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.
For primary bibliographic entry see Field 04A.
W70-10276

COMPREHENSIVE FLOOD PLAIN MANAGEMENT,
Office of the Chief of Engineers (Army), Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-10355

6G. Ecologic Impact of Water Development

EFFECTS OF WATER IMPOUNDMENTS ON REPRODUCTION AND POPULATION NUMBER OF WATERFOWL ON THE SNAKE RIVER, WASHINGTON,
Washington State Univ., Pullman. Dept. of Wildlife Biology.
Irven O. Buss.
Available from NTIS as PB-194 456, $3.00 in paper copy, $0.65 in microfiche. Completion Report. 18 p, 4 tab, 2 fig. OWRR Project A-005-WASH (4).

Descriptors: *Geese (Wild), Ducks (Wild), *Ecology, *Waterfowl, Washington, Wildlife, *Canada Goose.
Identifiers: Snake River (Washington).

Data on nesting habits of the Canada Goose were collected in 1966, 1967, 1968, 1969, and 1970. During 1969 and 1970, significant differences from the 1954-65 data reported by Buss and Wing (1966) were noted. Sand or soil was preferred to rock for nest substrate. Twelve nest sites were reused one to four times between 1960 and 1967. One successful re-nesting attempt occurred with a 12-day re-nesting interval. Observations indicated that 50% or more of the gosling production on the Snake River came from cliff or riverbank nests. Broods remained within 1 mile of their island nests for several days and then moved slowly upstream or downstream. Many broods were reared in grassy pastures adjacent to the river. A rapid increase in geese in July and August, appearing shortly after the young gained greater mobility, suggested that geese had hatched in cliff and riverbank nests or had moved into the study area from elsewhere. Observations of marked geese and direct counts indicated that most locally reared geese as well as new arrivals left the study area in late August. Data on marked and banded birds indicated that at least a part of the local population wintered in east central Washington within 50 miles of the study area. Migrant geese began arriving on the Snake River in mid-September, and maximum numbers were observed in late November and December. About 25 percent of the geese observed in the winter were B.c. minima. None of the artificial islands or nesting structures were utilized for nesting during the first year after their construction.
W70-10117

AESTHETIC FACTORS IN PLANNING AND DESIGN OF LIBBY DAM,
Army Engineering District, Seattle, Wash.
Sydney Steinborn.
Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 96, No PO1, p 39-54, Jan 1970. 16 p, 14 fig.

Descriptors: *Concrete dams, Dams, *Aesthetics, *Architecture, Gravity dams, *Environmental effects, *Environmental engineering, Environment , Landscaping, Structural design, Powerhouses, *Planning, Transmission lines, Project planning.
Identifiers: Visitor centers, *Libby Dam, Mont, Beautification.

The aesthetic and environmental planning and design of the Libby Dam Project in northwestern Montana are presented. Libby Dam is 3,000 ft long, 420 ft high, and contains 4,000,000 cu yd of concrete. The dam is in a beautiful mountain valley, and a major effort was and is being made in design and construction to minimize the impact of this massive structure on the environment. Development of a comprehensive landscape plan for the dam and immediate vicinity by a prominent consulting architect is described. Considerable attention was given to accommodation and movement of the visiting public. Details of these concepts and a design flow chart of the aesthetic and environmental planning process are presented. (USBR)
W70-10149

ENVIRONMENTAL POLLUTION-A SELECTIVE BIBLIOGRAPHY.
Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. Information Services Section.
For primary bibliographic entry see Field 10.
W70-10228

THE HYDROLOGY OF FOUR STREAMS IN WESTERN WASHINGTON AS RELATED TO SEVERAL PACIFIC SALMON SPECIES,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 02E.
W70-10240

THE ECOLOGICAL BACKGROUND TO LAND-USE STUDIES IN TROPICAL AFRICA, WITH SPECIAL REFERENCE TO THE WEST,
Birmingham Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 02I.
W70-10309

POPULATION DENSITY AND AGRICULTURAL SYSTEMS IN WEST AFRICA,
Salford Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 03F.
W70-10310

MAN-WATER RELATIONS IN THE EAST CENTRAL SUDAN,
Birbeck Coll., London (England). Dept. of Geography.
Anne Graham.
In: Environment and Land Use in Africa, Chapter 15, p 409-445, Methuen, London, 1969. 9 fig, 1 tab, 6 ref.

Descriptors: *Economic impact, *Social function, *Social charge, *Semiarid climates, Agriculture, Grazing, Rainfall, Wells, Tropical regions, Water supply, Rural sociology, Human population, Livestock.
Identifiers: *Peasant agriculture, *Sudan, *Nomadism, *Immigration, Transhumance, Sedentarism, Hafirs, Local movement.

In contrast to large-scale irrigation projects rural water schemes have the advantage of spreading benefits over a large area with minimal costs and political problems. Ghedaref District in the central Sudan is a generally semiarid region with a seasonal rainfall whose mean value decreases from south to north. The population is made up of many races with diverse ways of life from several parts of Africa. Water supplies range from consistently abundant and reliable to seasonal and highly unreliable. Agriculture varies from grazing to sesame and dura sorghum crops with only a few areas growing cotton and vegetables. The ways of life are determined by water supplies and are of 4 main types: (1) nomadism, (2) transhumance, (3) local movements, and (4) sedentarism. The dominant clay plain has recently been exploited by governmental construction of excavation reservoirs (hafirs) which act as catchments during the rainy season, facilitating more extensive agriculture and year-round settlements. This has increased immigration and the increased population densities have in turn often acted to extend old problems rather than solve them. The resulting effects on the economics and sociology of the region are discussed. (Casey-Arizona)
W70-10311

FOLKLORE AND BROMIDES IN WATERSHED MANAGEMENT.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-10410

07. RESOURCES DATA

7A. Network Design

OPTIMUM OPERATING PROCEDURE FOR A RIVER GAGING STATION ESTABLISHED TO

PROVIDE DATA FOR DESIGN OF A WATER SUPPLY PROJECT,
Geological Survey, Washington, D.C.
Marshall E. Moss.
Water Resources Research, Vol 6, No 4, p 1051-1061, August 1970. 11 p, 9 fig, 14 ref.

Descriptors: *Data collections, *Optimization, *Cost-benefit analysis, *Hydrologic data, *Gaging stations, Water yield, Reservoir design, Streamflow forecasting, Economics, Statistics, California.
Identifiers: Sensitivity analysis, Data costs.

A scheme for determining the optimum length of streamflow record and the optimum frequency of discharge measurements was applied to the gaging station on Arroyo Seco, an intermittent stream near Soledad, California. If the streamflow record is used only in the design of a water supply reservoir at the gage site, the optimum record length is found to vary between 9 and 56 years, depending on nonhydrologic time constraints. The optimum frequency of measurement of discharge for calibration of the station rating curve is found to be indeterminate. Sensitivity analysis indicates that the optimum length of record is more sensitive to the variability of the streamflow and the planned level of development at the site than to discount rate or cost of obtaining streamflow data. (Knapp-USGS)
W70-10057

ESTIMATING COEFFICIENTS OF A FLOW GENERATOR FOR MONOTONE SAMPLES OF DATA,
American Univ., Washington, D.C.; and Geological Survey,
David S. Crosby, and Thomas Maddock, III.
Water Resources Research, Vol 6, No 4, p 1079-1086, August 1970. 8 p, 13 tab, 8 ref, append.

Descriptors: *Synthetic hydrology, *Data collections, *Time series analysis, Correlation analysis, Streamflow forecasting, Statistical methods, Statistics, Regression analysis, Hydrologic data, Gaging stations.
Identifiers: Monotone samples.

If a set of flow records continuous in collection to the present has different starting times, it forms a monotone sample. The monotone sample may yield an inconsistent lag zero convariance matrix. In addition, it may be impossible to calculate real-value coefficients for a flow generator, leading to some complex values for the synthetic flow trace. A technique is presented that produces a consistent lag zero covariance matrix and a realvalue multisite streamflow generator. (Knapp-USGS)
W70-10068

TRITIUM AND HYDROGEOLOGY-INVESTIGATIONS AND MEASUREMENTS CARRIED OUT AT THE GRENOBLE NUCLEAR RESEARCH CENTER (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
J. Guizerix, R. Margrita, M. Launay, and P. Ruby.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/31, p 433-450, 1967. 18 p, 17 fig, 6 ref.

Descriptors: *Tritium, *Fallout, Groundwater movement, *Karst, *Aquifers, Hydrogeology, Tracers, Tracking techniques, Sampling, Hydrologic data, Monitoring.
Identifiers: France.

Tritiated water of thermonuclear origin is a new and very interesting parameter of which the hydrogeologist is making increasing use in the study of various problems. In karsts, the water from precipitation shows an annual maximum of concentrations in June. This signal can be used to establish correlations between the losses from an aquifer and resurgence about 30 km away, by means of a series of systematic measurements of the precipitation supplying aquifers and springs. These measurements have been valuable in a trial project involving a gamma-emitting tracer. A network for the collection of atmospheric tritiated water was set up for the collection and measurement of monthly samples collected at 26 stations spread fairly evenly across France. Its purpose is twofold: Primarily to constitute a bank of samples, or sampling data, for use in any subsequent hydrological studies carried out in France; and secondly, to permit study of the spatial distribution of tritium fallout. Tritium isoconcentration curves show a sea/continent effect, whereby tritium concentraions increase inland. (Knapp-USGS)
W70-10097

ULTRASONIC FLOWMETER,
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 04A.
W70-10139

7B. Data Acquisition

REMOTE SENSING OF OIL SLICKS,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Water Quality Research.
For primary bibliographic entry see Field 05A.
W70-10045

IMPROVEMENTS IN THE VAN BAVEL-MYERS AUTOMATIC WEIGHING LYSIMETER,
Nebraska Univ., Lincoln.
Norman J. Rosenberg, and K. W. Brown.
Water Resources Research, Vol 6, No 4, p 1227-1229, August 1970. 3 p, 1 fig, 9 ref. OWRR Project A-001-NEB.

Descriptors: *Lysimeters, *Automation, *Instrumentation, Design, Equipment, *Evapotranspiration, Nebraska.
Identifiers: Automatic weighing lysimeters.

The performance of the Van Bavel-Myers lysimeter was improved in two units installed at Mead, Nebraska. The units function according to design specifications (0.01 mm precision; 0.05 mm accuracy) after the following modifications were made: (1) provide drainage to maintain underground portions of the lysimeter in a water free condition, (2) relocate the electrical junctions to assure high electrical resistance between ground and the strain gage load cell, and (3) make mechanical damping devices accessible for cleaning and adjustment. (Knapp-USGS)
W70-10062

THE MEASUREMENT OF GRADATION USING SURVEYED CROSS SECTIONS,
Forest and Range Experiment Station, Rangiora (New Zealand).
For primary bibliographic entry see Field 02E.
W70-10063

A CRITIQUE OF METHODS SIMULATING RAINFALL,
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 02B.
W70-10065

AUTOMATION OF ATOMIC ABSORPTION ANALYSES,
Geological Survey, Denver, Colo.
M. J. Fishman, and D. E. Erdmann.
French and German abstracts. Atomic Absorption Newsletter, Vol 9, No 4, p 88-89, July-August, 1970. 2 p, 1 fig, 3 tab, 1 ref.

Descriptors: *Chemical analysis, *Spectrophotometry, *Colorimetry, *Automation, *Analytical techniques, Laboratory equipment, Water analysis, Laboratory tests, Trace elements, Water quality, Water chemistry.
Identifiers: *Atomic absorption analysis, *Direct aspiration, Data printout.

An atomic absorption spectrophotometer is automated with a sampler, proportioning pump manifold, and strip-chart recorder. Copper, lithium, manganese, potassium, sodium, iron, and zinc are determined by direct aspiration from the sampler. The proportioning pump manifold is added to the system for the determination of calcium, magnesium, and strontium. It introduces, automatically, an interference suppressant to the samples prior to aspiration. The latter system can also be used to make dilutions. (Woodard-USGS)
W70-10089

STREAM GAUGING TECHNIQUES FOR REMOTE AREAS USING PORTABLE EQUIPMENT,
British Columbia Univ., Vancouver. Dept. of Geography; and Research Council of Alberta, Edmonton.
Michael Church, and Rolf Kellerhals.
Canada Inland Waters Branch Technical Bulletin No 25, Department of Energy, Mines and Resources, 1970. 89 p, 24 fig, 11 tab, 109 ref.

Descriptors: *Stream gages, *Discharge measurement, *Instrumentation, Flowmeters, Current meters, Gaging stations, Stage-discharge relations, Dye releases, Tracers, Tracking techniques, Streamflow, Discharge (Water), Water measurement.
Identifiers: *Portable stream gaging equipment.

A variety of streamflow measuring techniques applicable to rivers with peak flows up to 10,000 cfs are reviewed. The methods are primarily suitable for the economical collection of short-term records at inaccessible or isolated sites. The emphasis is on field practice, with considerable detail being presented for the major techniques. The methods discussed include estimates of runoff using basin survey data, stage-discharge relations, artificial controls, current meters, dilution methods, and tracers. (Knapp-USGS)
W70-10090

INVESTIGATION OF GROUNDWATER FLOW WITH RADIOCARBON,
Groningen Rijksuniversiteit (Netherlands).
For primary bibliographic entry see Field 02F.
W70-10092

THE APPLICATION OF RADIATION LOGS TO GROUNDWATER HYDROLOGY,
Geological Survey, Denver, Colo.
W. Scott Keys.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/33, p 477-488, 1967. 12 p, 4 fig, 6 ref.

Descriptors: *Borehole geophysics, *Radioactivity techniques, Hydrogeology, Aquifers, Radioactivity, Tracers, Logging (Recording), Subsurface investigations, Groundwater movement, Nuclear moisture meters, Boreholes.
Identifiers: Radiation well-logs, Test wells.

The only technique available at present for obtaining geological and hydrological information through the casing of pre-existing water wells and other boreholes is by radiation logging. Inexpensive portable radiation logging equipment is available or has been developed for groundwater studies in connection with a general research project on the application of borehole geophysics in groundwater hydrology. It is possible to obtain data on the following: the source, velocity, and chemical quality of groundwater; the location, extent, geometry, bulk density, porosity, permeability, and specific

yield of aquifers and associated strata; and the position of casings, casing collars, leaks, perforations, and cement. The radiation logs employed include natural gamma, gamma-gamma, neutron-gamma, neutron epithermal-neutron, and radioactive tracer. Typical radiation logs obtained by the various techniques are described and examples are given of practical application of radiation logging to groundwater investigations. The applications cited are studies of perched water in basaltic rocks and associated sedimentary strata; the porosity, moisture content, and position of zones into which water was injected in volcanic tuff; the position of the interface between brine and fresh water in fine-grained carbonate rocks and associated fine clastic rocks; the interpretation of porosity from a neutron log, and the location by means of a radioactive tracer of the more permeable fracture zones in a well penetrating crystalline rock. (Knapp-USGS)
W70-10099

RADIOISOTOPE TRACERS IN LARGE-SCALE RECHARGE STUDIES OF GROUNDWATER,
Water Planning for Israel Ltd., Tel Aviv (Israel); and Weizmann Inst. of Science, Rehovoth (Israel).
R. Sternau, J. Schwarz, A. Mercado, Y. Harpaz, and A. Nir.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/34, p 489-505, 1967. 17 p, 9 fig, 24 ref.

Descriptors: *Tracers, *Groundwater movement, *Radioactivity techniques, *Tagging, Cobalt, Cobalt radioisotopes, Sampling, Pumping, Boreholes, Aquifers, Recharge, Monitoring, Radioisotopes.
Identifiers: Israel.

Dynamic investigations of large-scale groundwater recharge and mixing require a reliable tracing method. In the absence of natural tracer in the recharged water, tagging with Co-60 afforded excellent tracing possibilities. The hydrological basis, isotope production, injection, pumping, sampling procedures, and evaluation of results are described. For measurements of the pumped water in the field, a special gamma-detection system was designed. Small samples from observation boreholes were taken to the laboratory for measurements in another specially-designed system. Routine large-scale hydrological engineering applications of radio tracers are beneficial and feasible. Owing to the sensitivity and stability of the monitoring system, the concentration of tracer at input was low enough to ensure public protection without any sacrifice of precision. (Knapp-USGS)
W70-10100

SINGLE-WELL PULSE TECHNIQUE,
Geological Inst., Warsaw (Poland); Federal Experimental and Research Inst., Vienna (Austria); and Institute of Nuclear Research, Krakow (Poland).
M. Borowczyk, J. Mairhofer, and A. Zuber.
Supported by International Atomic Energy Agency. In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/35, p 507-519, 1967. 13 p, 6 fig, 1 tab, 8 ref.

Descriptors: *Tracers, *Tracing techniques, *Groundwater movement, *Aquifers, Groundwater basins, Sampling, Monitoring, Tagging, Radioisotopes, Boreholes.
Identifiers: Vienna Basin (Austria).

Some theoretical and experimental problems of the single-well pulse technique proposed in Israel are discussed. The single-well technique is based on a traced injection, pause and pumping. Knowing the thickness of an aquifer as well as the pumping rate, it is possible to find a distance travelled by a tracer during the pause from the measurement of tracer concentration in pumped water. The ratio of distance and duration of the pause gives natural groundwater velocity. The problem may sometimes be solved for a two-layered aquifer. A new method for interpreting the arrival time of the tracer is proposed. It is based on the time of 50% recovery of recovered amount of an injected tracer. Many limitations of the technique and an example of complex interpretation are discussed in detail. Final results are compared with those obtained from classical and other tracer methods. A general interpretation of all the data suggests that most of the water in the investigated part of the Vienna Basin flows very quickly through highly permeable zones and that the movement of water probably takes place mainly in the upper layers of the aquifer. (Knapp-USGS)
W70-10101

INVESTIGATIONS INTO GROUNDWATER BALANCE BY APPLYING RADIOISOTOPE TRACERS,
Research Inst. for Water Resources Development, Budapest (Hungary).
K. Ubell.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/36, p 521-530, 1967. 10 p, 5 fig, 5 ref.

Descriptors: *Tracers, *Tracking techniques, *Groundwater movement, *Soil water movement, *Water balance, Recharge, Sampling, Radioactivity techniques, Velocity, Mixing, Dispersion, Water resources development.
Identifiers: Hungary.

The methods used and the results obtained in Hungary in connection with field tests supplying radioactive tracers for solving the problems of natural groundwater balance are discussed. Moisture movements taking place through the aeration zone, recharge due to precipitation, and evaporation loss of groundwater are determined by systematic soil-moisture measurements carried out in whole vertical profiles, from the land surface down to the water table, with the aid of neutron-diffusion, based on the application of radioactive isotopes of Pu-Be source-detector as neutron radiation emitter. The flow of groundwater and horizontal movement in the zone of aeration as well as the velocity distribution according to depth are studied by multiwell tracing and single-well techniques by using I-131 tracers. (Knapp-USGS)
W70-10102

BOREHOLE DILUTION TECHNIQUES: A CRITICAL REVIEW,
International Atomic Energy Agency, Vienna (Austria); Federal Experimental and Research Inst., Vienna (Austria); and Institute of Nuclear Research, Kracow (Poland).
E. Halevy, H. Moser, O. Zellhofer, and A. Zuber.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/37, p 531-564, 1967. 34 p, 19 fig, 1 tab, 50 ref.

Descriptors: *Tracers, *Radioactivity techniques, *Groundwater movement, *Borehole geophysics, *Reviews, Bibliographies, Sampling, Monitoring, Aquifers, Mixing, Dispersion, Nuclear meters, Hydrogeology.
Identifiers: *Dilution techniques (Tracers).

Borehole dilution techniques for the determinations of filtration velocity, vertical flows and direction of groundwater flow are reviewed. The principles underlying each measurement, instrumentation, disturbing influences, and their possible correction are discussed and recommendations are made for applications and future research. (Knapp-USGS)
W70-10103

RADIOMETRIC METHOD OF SEEPAGE CONTROL IN DAMS AND THEIR ENVIRONS (RUSSIAN),
Polish Academy of Science, Gdansk. Inst. of Hydraulic Research.
J. Makowski.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/40, p 601-616, 1967. 16 p, 13 fig, 1 tab, 7 ref.

Descriptors: *Radioactivity techniques, *Tracers, *Seepage, *Reservoir leakage, Infiltration, Soils, Sands, Clays, Aquifers, Instrumentation, Sampling, Radioisotopes.
Identifiers: Poland.

For tracer studies of seepage, methods of choosing the injection point, techniques for introducing the radioactive solution into the soil, and the conditions that must be considered when selecting the radioisotope are described. The methods of measurement used are discussed, and a brief description of the equipment is given. A small probe was designed to measure the volumetric weight of the soil to determine the best injection point where the soil is most permeable. The radioisotopes used in the the investigations described are Cr-51 in the form Na2Cr04, Br-82 in the forms KBr and NH Br, I-131 in the forms NaI and KI, Sb-124 in the form SbC13 and Au-198 in the form HAuC14. Their adsorption values are given for pure sand soils, sand and clay mixtures and rocky soils (granite). (Knapp-USGS)
W70-10105

LABORATORY EVALUATION OF Cr-51 EDTA AS A TRACER FOR GROUNDWATER FLOW,
Chalmers Univ. of Technology, Goteborg (Sweden); and Ingeniors Vetenskaps Akademien, Stockholm (Sweden).
G. Knutsson, and H. G. Forsberg.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/42, p 629-652, 1967. 14 p, 10 fig, 2 tab, 15 ref.

Descriptors: *Tracers, *Groundwater movement, *Chromium, *Radioisotopes, *Chelation, Adsorption, Water chemistry, Tracking techniques, Tritium, Laboratory tests, Sampling, Monitoring, Calibrations.
Identifiers: EDTA complexes.

The Cr-51 EDTA complex can be used successfully for tracing groundwater movement. In many cases spiking of the Cr-51 tracer with tritium is advantageous, and a procedure has been worked out for their simultaneous determination by liquid-scintillation counting. This technique has proved to be particularly useful when the samples are not too dilute. The use of a flow cell for continuous recording during column tests was studied, and the possibility of applying this method to field investigations is discussed. Cr-51 EDTA, at concentrations down to 0.001 ppm, is neither adsorbed nor much retarded in minerals such as quartz, feldspars, some micas, calcite and dolomite. Some of the ferromagnesian silicates and other iron-bearing minerals have a considerable effect. Upon passage through secondary minerals, such as clay minerals, Cr-51 EDTA is retarded, and chlorite particularly causes a marked delay. Losses of the complex seem to occur in illite. Tritium is retarded more than Cr-51 EDTA in bentonite and in montmorillonite, and to some extent in the other clay minerals. Variation in pH or in flow-rate does not affect the behavior of Cr-51 EDTA. Some recent field experience of the use of Cr-51 EDTA in Sweden and elsewhere is discussed briefly. (Knapp-USGS)
W70-10106

APPLICATION OF THE INTEGRATION METHOD TO THE DETECTION OF WATER-

BORNE Cr-51-EDTA AND RADON ON ACTIVATED CARBON (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
J. Molinari, and J. Guizerix.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/43, p 653-668, 1967. 16 p, 14 fig, 9 ref.

Descriptors: *Tracers, *Groundwater movement, *Chromium, *Radioisotopes, *Chelation, Adsorption, Water chemistry, Tracking techniques, Calibrations, Activated carbon.
Identifiers: Radon.

The choice of a tracer for groundwater hydrology depends on the behavior of the tracer in relation to the ground it passes through and on the sensitivity with which it can be detected. Cr-51, which is recognized as a good radioactive tracer for groundwater is suggested, in a method in which enrichment is achieved by dripping labeled water onto activated carbon. At very low concentrations the radioactivity of the tracer was partly masked by the natural water radioactivity fixed in the carbon. The artificial tracer can be distinguished by differential gamma spectrometry. (Knapp-USGS)
W70-10107

CAPABILITIES AND POTENTIAL OF USAEC'S CURRENT METER FOR ULTRA-LOS-VELOCITY MEASUREMENTS,
Tennessee Valley Authority, Norris.
R. A. Elder, and S. Vigander.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/47, p 683-695, 1967. 13 p, 9 fig, 1 tab, 3 ref.

Descriptors: *Current meters, *Radioisotopes, *Tracers, *Streamflow, Tennessee Valley Authority, Project, Sampling, Monitoring, Flow, Reservoirs, Currents (Water), Limnology, Tracking techniques.
Identifiers: Low velocity current meter.

A low-velocity current meter operates on the time-of-travel principle using I-131 as the tracer. It was used during 1966 on a comprehensive study of the thermohydrodynamics of TVA's Fontana Reservoir. Inflow and outflow conditions in a highly stratified reservoir were studied in considerable detail. Velocities from 0.005 to 0.2 ft/s were present in the flow zones in both the upstream and downstream directions. (Knapp-USGS)
W70-10108

FUNDAMENTALS OF THE DISPERSION OF RADIONUCLIDES IN SANDY AQUIFERS,
Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium).
For primary bibliographic entry see Field 02F.
W70-10109

LOCALIZATION OF LEAKAGES FROM A LARGE RESERVOIR, USING RADIOACTIVE TRACERS (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleares.
J. Guizerix, J. Molinari, B. Gaillard, H. Santos Cottin, and A. Mornas.
In: Isotopes in Hydrology, Proceedings Symposium of International Atomic Energy Agency and International Union Geodesy and Geophysics, Vienna, Nov 14-18, 1966: International Atomic Energy Agency STI/PUB/141, Vienna, Paper No SM-83/39, p 587-599, 1967. 13 p, 10 fig, 13 ref.

Descriptors: *Tracers, *Reservoir leakage, *Tracking techniques, *Radioactivity techniques, Radioisotopes, Tagging, Seepage, Infiltration, Dams, Reservoirs.
Identifiers: Reservoir leak tracing.

Radioactive tracers were used to establish the source of losses from an earth dam. The zones of infiltration were determined by injecting radioactive tracers in the lake at points and along lines over distances of about 50 m. The radioactivity of the water was then checked at the outlet from the dam's drains, and curves were prepared showing the point at which the radioactive cloud reached the bottom of the water in the reservoir; this was done by using a nuclear probe lowered over the side of a boat whose position was plotted from the bank. The envelope of the curves obtained when activity is detected at the outlet of the drains defines the infiltration area of the lost water. A detailed explanation is given of the technique and the modifications which might be necessary to suit special situations which can arise; these consist of using tracers easily adsorbed onto the bottom of the stored water, the use of labeled sediments and the injection of tracers through pierced tubes placed at the bottom of the reservoir. (Knapp-USGS)
W70-10110

THE FLOW OF A STREAM THROUGH A RESERVOIR,
Gemeinnutziges Institut, Duesseldorf (West Germany).
For primary bibliographic entry see Field 02E.
W70-10111

REMOTE SENSING OF EARTH RESOURCES, A LITERATURE SURVEY WITH INDEXES.
National Aeronautics and Space Administration, Washington, D.C.

Available from NTIS as NASA SP-7036, $10.00 in paper copy. Special Publication NASA SP-7036, September 1970. 1221 p, 3684 ref.

Descriptors: *Bibliographies, *Remote sensors, Agriculture, Forestry, Environmental effects, Geodesy, Cartography, Geology, Mineralogy, Oceanography, Marine Geology, Hydrology, Data processing, Instrumentation, Geophysics, Satellites (Artificial).
Identifiers: *Earth resources, Cultural resources.

This literature survey lists 3684 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1962 and February 1970. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, oceanography and marine resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis.
W70-10126

MINIMIZING ERRORS IN GAMMA-RAY SURFACE-TYPE DENSITY GAGES: EXISTING GAGES AND NEW DESIGN CONCEPTS,
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 08G.
W70-10143

METHODS OF DETERMINATION OF WATER IN MATERIALS OF DIFFERENT STATE OF AGGREGATION (IN RUSSIAN),
Chemico-Technological Inst., Moscow (USSR).
For primary bibliographic entry see Field 02G.
W70-10168

IMPROVING TREE TRANSPIRATION ESTIMATES BASED ON HEAT PULSE VELOCITY MEASUREMENTS,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02D.
W70-10286

ASSAYING ALGAL GROWTH WITH RESPECT TO NITRATE CONCENTRATION BY A CONTINUOUS FLOW TURBIDOSTAT,
California Univ., Berkeley; and Ministry of Health, Jerusalem (Israel).
For primary bibliographic entry see Field 05A.
W70-10403

INTERPRETING NEUTRON PROBE READINGS IN FROZEN SOIL.
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
Richard A. Sartz.
USDA Forest Service Res Note NC-77, 1969. 4 p.

Descriptors: *Soil water movement, *Gravitational water, *Hydrologic properties, *Infiltration, Moisture content, Percolating water, Permeability, Soil physics, Wisconsin, Nuclear meters.
Identifiers: Interflow.

Several factors associated with soil freezing complicate the inperpretation of neutron probe readings in frozen soil. Temperature is unimportant, but the effect of vertical resolution must be considered. Because of the possibility of both gains and losses of water at the same depth during a period of measurement, interpreting changes in the water content of frozen soil is a subjective process. (Sartz-Forest Service)
W70-10412

A DEVICE FOR MEASURING SOIL FROST,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
James H. Patric, and Burley D. Fridley.
USDA Forest Service Research Note NE-94, 1969. 7 p, illus.

Descriptors: *Frost, *Frozen ground, *Frozen soils, Freezing, Heat transfer, Soil temperature, West Virginia.

A water-filled plastic tube buried vertically in the soil in a copper casing permitted repeated observation of frost depth without damaging the sampling site. The device is simple and inexpensive and provides data on soil freezing at least as accurate as direct observation by digging through frozen soil. (Patric-Forest Service)
W70-10415

7C. Evaluation, Processing and Publication

LEAST SQUARES ESTIMATION OF CONSTANTS IN A LINEAR RECESSION MODEL,
Kentucky Univ., Lexington.
For primary bibliographic entry see Field 06A.
W70-10052

A NUMERICAL SOLUTION FOR FINITE AMPLITUDE FREE SURFACE WAVES,
Arizona Univ., Tucson.
D. D. Fangmeier.
Water Resources Research, Vol 6, No 4, p 1216-1219, August 1970. 4 p, 3 fig, 10 ref.

Descriptors: *Computer programs, *Waves (Water), *Open channel flow, Linear programming, Streamflow, Velocity, Hydraulic models, Digital computers.
Identifiers: Wave tanks.

A technique for the numerical solution of two-dimensional potential flow with a free surface and gravity is presented. Its validity is demonstrated by application to wave generation by a pressure on a segment of the free surface of a ponded fluid. Wave profiles are obtained for the leading waves of progressive approximately periodic wave formations that show the effect of retaining the nonlinear

terms in the free surface boundary conditions. The programming is relatively simple and the technique applicable to other wave forming situations. However, long computation times are required. (Knapp-USGS)
W70-10060

RUNOFF GENERATION IN WESTERN WASHINGTON AS A FUNCTION OF PRECIPITATION AND WATERSHED CHARACTERISTICS,
Washington State Univ., Pullman. Coll. of Engineering Research Div.
For primary bibliographic entry see Field 02A.
W70-10122

A DIGITAL MODEL FOR AQUIFER EVALUATION,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-10238

SELECTION OF FREQUENCY DISTRIBUTION MODELS,
Nevada Univ., Reno.
For primary bibliographic entry see Field 02A.
W70-10246

QUASILINEARIZATION AND NONLINEAR PROBLEMS IN FLUID AND ORBITAL MECHANICS,
North American Rockwell Corp., Downey, Calif.
For primary bibliographic entry see Field 08B.
W70-10272

SPECTRAL ANALYSIS--APPLICATIONS IN WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D.C. Estuarine and Oceanographic Programs Branch.
For primary bibliographic entry see Field 05A.
W70-10279

08. ENGINEERING WORKS

8A. Structures

DESIGN OF BOUNDARY ARCH DAM,
Bechtel Corp, San Francisco, Calif.
Jaroslav Pospisil, and Michael D. Hayes.
Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 96, No PO1, p 73-91, Jan 1970. 19 p, 12 fig, 3 tab, 5 ref, append.

Descriptors: *Arch dams, Dam construction, *Dam design, *Concrete dams, Stress analysis, *Structural analysis, Dams, Electric analogs, Grouting, Simulation analysis, Analog models, Contraction joints, Instrumentation, Spillway gates, Sluice gates, Uplift pressure, Dam foundations, Cooling, Diversion, Engineering geology, Foundation investigations, Abutments.
Identifiers: *Thin arch dams, *Double-curvature arch dams, *Boundary Dam, Wash, Overtopping.

Preliminary design of the 360-ft-high, double-curvature, thin-arch dam was based principally on the crown cantilever adjustment method. Final design was based on the electric analogy simulation method whereby instead of constructing an analogy model, equations were written to simulate the analog and solved analytically by computer. The dam is equipped with 7 large sluice gates located 200 ft below the crest, 2 spillway gates, and ice and trash skimmer gate, and a horizontally moving maintenance gate to serve all sluice openings under full reservoir head. Arrangement and grouting of contraction joints, concrete cooling, instrumentation, site investigation and geology, hydrology, and abutment stability analysis are described. The design allowed for overtopping the partially completed dam during the flood season. (USBR)
W70-10142

PERMAFROST PRESENTS MECHANICAL CHALLENGES,
Kroeker (J. Donald) and Associates, Portland, Oreg.
J. Donald Kroeker.
Building System Design, Vol 67, No 5, p 17-22, May 1970. 6 p, 10 fig, 4 ref.

Descriptors: *Permafrost, Freezing, Foundation investigations, *Frozen ground, Cold regions, *Foundations, Thawing, *Frozen soils, Ventilation, Cold weather construction, Frost action, Frost heaving, Structures, Pile foundations, Refrigeration, Supports, Refrigerants, Insulation, *Piping systems (Mechanical), Slabs, *Buildings.
Identifiers: Cold climates, Building design, Ice lenses, *Cooling systems.

Prevention of thawing of permafrost upon which buildings and structures for conveying piping rest is a major problem in the frozen north. Permafrost is the permanently frozen ground below the active layer of ground subject to freezing and thawing. A type of foundation that has become traditional and is still used in many buildings through 4 stories in height consists of pilings extending into stable permafrost with first floors at least 4 ft above ground to prevent thawing beyond the active layer by heat transmission from the building. This type of support requires drilling holes into the permafrost, setting piling, backfilling with slurry, then waiting for freeze-back that may take several months. Piping systems for water supply, heating, and sewage disposal are run in utilidors also above grade. In the case of slab-on-grade foundations or in extremely high load conditions, a means of freezing the active frost zone is provided. For foundations set directly on permafrost, a means is provided to maintain the permafrost in a frozen condition. Several artificial freezing systems for foundations are discussed. Typical designs from Army Technical Manual TM5-582 for protection of permafrost under structures having floor levels above and on grade are presented. (USBR)
W70-10144

ARCH DAM DESIGN: STATE OF THE ART,
Bureau of Reclamation, Denver, Colo.
Merlin D. Copen, and Loyd R. Scrivner.
Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 96, No PO1, p 93-108, Jan 1970. 16 p, 9 fig, 1 tab, 4 ref, append.

Descriptors: *Arch dams, Concrete dams, Dams, *Dam design, Deflection, Shape, Structural analysis, Structural behavior, Design criteria, Loads (Forces), Trial-load method, Safety factors, Stress analysis, Damsites, Tensile stress, Thrust, Dam foundations, Spillways, Foundation investigations, Rock mechanics.
Identifiers: Thin arch dams, Double-curvature arch dams, *Design practices, *Design improvements, Computer-aided design.

Prominent trends in arch dams include using thinner, more complex shapes that take advantage of inherent structural qualities of arch dams and adapt to more difficult site conditions. Large- and small-scale structural qualities of arch dams and adapt to more difficult site conditions. Large- and small-scale structural models are used for arch dam analysis; development of electronic computers has made the use of several complex and comprehensive methods of analysis feasible, including the trial-load, shell-theory, finite element, and dynamic-relation methods. The methods permit rapid, reliable evaluation of many alternative solutions for each site, subjected to all anticipated loading conditions. Good comparisons between computed and measured prototype behavior have substantiated design analyses. Better understanding of foundation requirements and rock mechanics has contributed greater safety and efficiency to arch dam design. Computed safety factors of 4 to 1 are usually required for arch dams for normal loading condtions, with a reduction permitted for unusual loading. If design features permit their consideration, orifice or overflow free-fall spillways may be more economical than tunnel or side channel spillways usually designed for arch dams. (USBR)
W70-10146

SELECT RESERVOIR WITHDRAWAL BY MULTILEVEL INTAKES,
Army Engineer District, Savannah, Ga.
Walter B. Benton, William J. Wall, and Shelton R. McKEEVER.
Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 96, No PO1, p 109-115, Jan 1970. 7 p, 3 fig, 1 tab.

Descriptors: *Reservoir operation, Reservoir storage, Reservoirs, *Withdrawal, *Intakes, *Outlets, Stratification, Water quality, Outlet works, Hydraulic models, Intake structures, Thermocline, Saline water, North Carolina, *Water quality control.
Identifiers: *Selective level releases, *Multilevel outlets, New Hope Reservoir, N C/ Army Engineer Waterways Expt Sta.

Hydraulic model tests verify that multilevel intakes are an effective design for selective reservoir withdrawal. New Hope Dam and Reservoir, Cape Fear River Basin, N C, uses a multilevel intake design for selective withdrawal of impounded water as an aid in water quality control. The intakes permit flexibility in selecting the stratum from which reservoir releases are made. The model test results indicated that the proposed structure will provide effective regulation for control of water quality during the summer (minimum and average flows of 300 cfs and 800 cfs). Flows of 2400 cfs can be released without withdrawing flow below the thermocline, provided both sides of the intake structure are used and the thermocline is 40 ft below the upper pool elevation. The model indicated that operational releases of 2700 cfs through only one side of the structure will withdraw quantities as great as 10% to 33% from below the thermocline located from 40 to 90 ft, respectively, below the surface of the upper pool. The lower side intakes are least effective in drawing from the upper stratum. This may be improved by locating the structure farther away from the earth dam embankment. Model studies revealed that vibration of intake tower would not be a problem. (USBR)
W70-10147

EFFECTS OF RESERVOIR IMPOUNDMENT ON WATER QUALITY,
Army Engineer District, Savannah, Ga.
For primary bibliographic entry see Field 05G.
W70-10148

AESTHETIC FACTORS IN PLANNING AND DESIGN OF LIBBY DAM,
Army Engineering District, Seattle, Wash.
For primary bibliographic entry see Field 06G.
W70-10149

ECONOMIC LOCATION OF LOCKS,
Eric E. Bottoms.
Bulletin of the Permanent International Association of Navigation Congresses, Vol 3/4, No 2, p 45-55, 1968-1969. 20 fig, 19 ref.

Descriptors: *Locks, River basin development, Channel improvement, Inland waterways, Channels.
Identifiers: *Lock location, *Lock design, Mississippi River, Ohio River, Monongahela River, Tennessee River, Gallipolis Dam and Locks, Welland Canal.

The size and location of navigation locks are determined by many factors: economic, geologic, the nature of traffic, ease and safety of navigation. The latter two are often neglected in order to curtail costs, with the result sometimes being difficult and hazardous navigation, and inefficient operation

which increases user costs. The author states that, 'the needs of the customer are paramount and deserve first consideration,' and therefore locks and navigation facilities should be designed to maximize user benefits. Trends in barge size are discussed with respect to their effect on the efficiency of existing waterways and locks, which is in turn related to the serviceability of the facilities to the customer. The importance of proper design of features such as filling systems and guard walls in reducing the lockage interval is elucidated. The location of locks with respect to river bends and currents is discussed. Several examples of poorly located facilities are presented and the adverse effect of their location is demonstrated. The use of model studies and consultation of the towing industry is advocated in determining optimum lock location. (Hewett-Rutgers)
W70-10349

MILLER V UNITED STATES (EVALUATION OF LAND CONDEMNED BY UNITED STATES).
For primary bibliographic entry see Field 04A.
W70-10428

8B. Hydraulics

EVOLUTION OF TIDEWATER PORT,
Tulane Univ., New Orleans, La. School of Engineering.
Chester A. Peyronnin, Jr.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW2, Paper 7287, p 387-394, May 1970. 8 p, 6 fig.

Descriptors: *Mississippi River, *Tides, *Sedimentation, *Harbors, *Louisiana, Inland waterways, Storms, Water level fluctuations, Saline water intrusion.
Identifiers: Port of New Orleans (La).

A portion of the Port of New Orleans consists of an inner harbor connected to the Gulf of Mexico and Lake Pontchartrain. The growth of this inner harbor is discussed with major emphasis on the hydraulic aspects. Such problems as current flow in the waterway complex, tidal flows and storm surges, salinity regime changes, and sedimentation in the waterway are discussed. (Knapp-USGS)
W70-10088

INTERNAL CURRENTS RESULTING FROM INTERMEDIATE DENSITY INFLOWS INTO STRATIFIED RESERVOIRS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 02E.
W70-10121

THE FLOW OF ROUND BUOYANT JETS ISSUING VERTICALLY INTO AMBIENT FLUID FLOWING IN A HORIZONTAL DIRECTION,
Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 05G.
W70-10209

BOUNDARY SHEAR STRESS IN RIVERS AND ESTUARIES,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-10257

QUASILINEARIZATION AND NONLINEAR PROBLEMS IN FLUID AND ORBITAL MECHANICS,
North American Rockwell Corp., Downey, Calif.
John R. Radbill, and Gary A. McCue.
New York, American Elservier Publishing Company, Inc, 1970. 228 p, 97 fig, 65 ref, 1 append.

Descriptors: *Flow, *Porous media, *Fluid mechanics, *Mathematical studies, Dynamic programming, Linear programming, Open channel flow, Hydrodynamics, Laminar flow, Turbulent flow, Boundary processes, Shear drag, Boundary layers, Reynolds number.
Identifiers: Quasilinearization.

This book is concerned with the analysis, formulations, and computational sophistication involved in the use of quasilinearization, a modern mathematical technique particularly suited to digital computer applications. It is a straightforward computational technique for solving systems of nonlinear differential equations, subject to two-point or multiple-point boundary conditions, in reasonable computing times. The method of quasilinearization leads to a scheme of successive approximations that converges rapidly (quadratically) and that requires moderate amounts of computation at each stage. Methods are given for solving fluid mechanics problems involving laminar boundary layers on walls bordering flowing fluids. The Falkner-Skan extension of the Blasius equation is examined because it displays, in a simple equation, the nonlinear (bilinear) behavior typical of boundary-layer problems and two point boundary conditions. A description and listing are presented for a general quasilinearization program. Most of these techniques are designed for use in solving problems in high-velocity fluid dynamics, plasma flow, and spacecraft orbital computation, but they are also useful for solving problems of laminar and turbulent pipe flow, open channel flow, and groundwater movement. (Knapp-USGS)
W70-10272

HYDRAULIC FIELD TESTS ON A SETTLING BASIN,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 05D.
W70-10379

8C. Hydraulic Machinery

MULTIPLE PURPOSE DEVELOPMENT OF THE ARKANSAS RIVER PROJECT INCLUDES HYDROELECTRIC POWER STATIONS OF UNUSUAL DESIGN,
Allis-Chalmers Mfg. Co., York, Pa.
W. L. Thomasson, and H. L. Reynolds.
Allis-Chalmers Report 54P4213, 1970. 8 p, 11 fig, 2 tab, 2 ref.

Descriptors: *Tube turbines, Hydraulic turbines, Kaplan turbines, Peak loads, Hydroelectric power, *Hydroelectric plants, Axial flow turbines, Multiple-purpose projects, Francis turbines, Locks, Electric generators, *Economic justification, Navigation, Electric power production, Costs.
Identifiers: Arkansas River, *Low-head hydro plants, Ozark Powerplant (Ark), Webbers Falls Powerplant (Okla), R S Kerr Powerplant (Okla).

Innovations in tube turbine development resulted in its use in the Ozark and Webbers Falls Powerplants on the Arkansas River, and may reopen many of the nation's low-head undeveloped hydroelectric sites. Prior to the tube turbine, the Francis, Kaplan, and fixed-blade propeller designs, all with vertical settings, have been used for low-head sites. In most cases, very low-head sites could not be justified economically with conventional units, but development of the tube turbine makes many of the uneconomical sites attractive. Installations at the Ozark and Webbers Falls plants are compared with the nearby R S Kerr plant which has a conventional Kaplan turbine in a vertical setting. (USBR)
W70-10129

ELECTROMAGNETIC CHARACTERISTICS OF ISOLATED BUNDLE CONDUCTORS,
Hong Kong Univ.
S. Y. King, and J. J. Raftery.
Proc Inst Elec Eng (Engl), Vol 117, No 4, p 753-760, Apr 1970. 8 p, 11 fig, 3 tab, 10 ref, append.

Descriptors: *Transmission (Electrical), *Bundled conductors, Digital computers, Transmission lines, *Electromagnetic properties, Electric currents, Alternating current, *Mathematical analysis, Resistance, Inductance, Magnetic fields, Foreign research, Errors, Conductors, Analytical techniques.
Identifiers: China, Test results, *Accuracy, *Current density, Skin effect (Electrical), Electric conductors.

With increased voltage for power transmission, bundled conductors have become more widely used. A numerical method of obtaining the electromagnetic characteristics of bundled conductors by a digital computer is given. Accuracy of the method is assessed by applying it to isolated conductors that involve analytic solutions. The method of solution uses successive approximations to the integral equations, and a highly convergent in all practical cases. Results confirming the technique are tabulated, the maximum error being 0.05%. (USBR)
W70-10133

GOBERNING CHARACTERISTICS FOR 820,000 HORSEPOWER UNITS FOR GRAND COULEE THIRD POWERPLANT,
Bureau of Reclamation, Denver, Colo.
F. R. Schleif, and C. G. Bates.
Translation, Paper 70 TP 527-PWR, Inst Elec Electron Eng Summer Power Meet EHV Conf, Los Angeles, Calif, July 1970. 7 p, 10 fig, 10 ref.

Descriptors: *Hydraulic turbines, *Speed regulators, Field tests, *Characteristics, Control, Mechanical properties, Performance, Thermal power, Hydroelectric power, Servomechanisms, Hydroelectric plants, Peaking capacities, Sensitivity, Stability, *Governors.
Identifiers: *Response time, Grand Coulee Powerplant, Wash, Base loads, Dashpots, Interconnected systems, *Governors (Hydraulic).

In selecting parameters for large hydropower generating units such as those selected for the Grand Coulee Third Powerplant, control characteristics to satisfy power system needs can strongly influence economics of the design. Need for abnormal mechanical inertia and expensive reduction of the penstock water starting time are mitigated by refinement of governor characteristics. Methods are described for selecting controllability to mechanical inertia and the penstock time constant to facilitate economic proportioning. The influence of a governing system and its refinement with several new features for improved performance are discussed. (USBR)
W70-10135

AUTOMATIC MECHANICAL IRRIGATION GATES,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.
Allan S. Humpherys.
Seventh Congress on Irrigation Drainage, Quest 24, Rep Disc, R I-R24, Mexico City, p 24.251-24.261, 1969. 21 p, 12 fig, 1 ref.

Descriptors: *Irrigation systems, *Turnout gates, Irrigation, Gates, Automatic control, Water distribution (Applied), *Automation, *Surface irrigation, Design.
Identifiers: Labor savings, Floating weeds.

Small automatic irrigation gates for farm distribution systems are being developed to improve the efficiency of water use and to save labor. Two general classes of gates are described: (1) fully automatic gates that operate from energy of the water flowing in the ditch and require a minimum of attention from the operator; and (2) semiautomatic gates that require resetting or moving at each irrigation. Gate design and operating mechanisms for automatic and semiautomatic irrigation systems are

reviewed. An important requirement for all automatic irrigation systems is that the water and ditches be kept weed-free. Design of any automatic irrigation system should include a weed-screening device. (USBR)
W70-10145

TASK II REPORT: SURVEY OF POWER PLANT OPERATING CHARACTERISTICS AND DESIGN CRITERIA,
Dynatech R/D Co., Cambridge, Mass. Thermal Engineering Group.
For primary bibliographic entry see Field 05G.
W70-10316

GEORGIA POWER CO V FEDERAL POWER COMM'N (LICENSING OF HYDROELECTRIC POWER PLANT).
For primary bibliographic entry see Field 06E.
W70-10457

ALABAMA POWER CO V FEDERAL POWER COMM'N (FEDERAL POWER COMMISSION'S DETERMINATION OF HYDROELECTRIC PROJECT COSTS).
For primary bibliographic entry see Field 06E.
W70-10459

8D. Soil Mechanics

RADIOMETRIC METHOD OF SEEPAGE CONTROL IN DAMS AND THEIR ENVIRONS (RUSSIAN),
Polish Academy of Science, Gdansk. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 07B.
W70-10105

AUSTRALIAN TRENDS IN TUNNEL FORMWORK,
A. N. Sharley.
Tunnels and Tunnelling, Vol 2, No 2, p 93-97, Mar-Apr 1970. 3 p, 5 fig.

Descriptors: *Tunnel construction, Tunneling, Tunnel linings, Tunnels, *Formwork (Construction), Foreign construction, Construction materials, Handling equipment, Foreign design practices, Arch.
Identifiers: Australia, Construction methods, Curbs, Tunnel supports, Construction practices.

Primary tunneling methods and design, construction, and handling of tunnel formwork in Australia are described. Most large tunnels driven in Australia have been constructed by using curb pours, followed by arch pours, and finished by invert pours. This has been a convenient method of construction, particularly for horseshoe-shaped tunnels. The method allows use of light, relatively portable forms to establish the curb to line and level and permits part of the tunnel lining to be placed, forming the basis of rapid location for heavy arch forms and invert forms or for traveling screeds for the invert. Curb forms have generally been of light construction, supported on stakes in the floor of the tunnel and spaced from the excavation at the upper edge of the forms by rock ties. Panel construction has been of suitably ribbed, light gage steel. Arch forms have been designed to be self-supporting between the curbs or the sides of the invert, with hinge locks incorporated to ensure that the form assembly acts as a 2- or 3-pin arch. Current practice in Australia is to fabricate forms so that the skin sheet and all supporting members are of integral construction. Transport of forms in tunnels is by a special-purpose, rail-mounted form-traveler or jumbo. (USBR)
W70-10127

LLYN BRIANNE DAM, SOUTH WALES,
W. J. Carlyle.
Civ Eng Pubic Works Rev, Vol 64, No 761, p 1195-1200, Dec 1969. 5 p, 9 fig, append.

Descriptors: *Earth dams, *Rockfill dams, Dam foundations, Dams, *Dam design, *Dam construction, Instrumentation, Geology, Grout curtains, Soil compaction, Earth materials, Foreign construction, Outlet works, Zoned embankments, Transition zones, Rock foundations, Rock properties, Soil properties, Grouting, Spillways, Drains, Diversion tunnels.
Identifiers: Blanket grouting, Dam stability, Chute spillways, Outlet tunnels, Great Britain, Sprayed concrete.

Llyn Brianne Dam, now being constructed on the River Towy, consists of an earth and rockfill embankment, an open chute spillway, tunnel diversion and outlet works, and fish handling facilities. Site geology, embankment design, materials selection, instrumentation, foundation treatment, features of the appurtenant structures, and construction are discussed. The dam embankment is 300 ft high and consists of a thin earthfill core protected by filter and transition zones and outer shells of rockfill. Rockfill is compacted in 3-ft layers by 4 passes of an 8.5-ton vibrating roller. Earthfill is compacted slightly wet of optimum water content in 12-in. layers by the 8.5-ton vibrating roller or by a 50-ton rubber-tired roller. The dam foundation is indurated slaty mudstone with minor graywacke beds covered by light overburden. Other than stripping overburden, foundation treatment is confined to the core contact area and includes excavation of open-jointed rock, removal of cliffs and crags, filling of local irregularities with dental concrete, coating the area with pneumatically applied cement mortar, blanket grouting the area, with curtain grouting up to 200 ft deep for the length of the dam. (USBR)
W70-10131

8E. Rock Mechanics and Geology

THE INFLUENCE OF ROCK CHARACTERISTICS ON THE STABILITY OF ROCK CAVITIES,
G. Lombardi.
Tunnels and Tunnelling, Vol 2, No 1, No 2, p 19-22, 104-109, Jan-Feb, Mar-Apr, 1970. 10 p, 17 fig, 5 ref.

Descriptors: *Rock mechanics, Rock properties, *Cavities, Deformation, *Tunnels, Tunnel pressures, Tunnel design, Stress distribution, Fissures (Geology), *Stress analysis, Anisotropy, *Stability, Foreign research, Tunnel linings, Residual stress, Discontinuities, Lateral forces, Strain, Stress.
Identifiers: *Rock pressure, Stress ratio, Openings, Rock dilation, Switzerland, Underground openings.

Concepts concerning the forces about cavities in rock formations are discussed. Included are: (1) natural or preexisting state of stress in rock, (2) rock properties that determine the effects of man-made changes to the geologic structure, (3) continuous and discontinuous rock systems, and (4) mechanical reactions of rock around an excavation. Results of a few analyzed cases show the effects in a tunnel of anisotropy and variation of inside pressure, friction angle, and laterial pressure. To determine formation pressure exerted on a tunnel lining, knowledge of the following values is essential: (1) existing stress conditions in the formation before construction begins, especially the ratio of vertical to horizontal stress; (2) cohesion and friction angle along fissure systems; and (3) volume increase caused by failure in the formation. With these values and a mathematically usable formulation of the construction sequence, all practical cases of cavities in rock can be analyzed. (USBR)
W70-10128

THE STABILITY OF PARTLY IMMERGED FISSURED ROCK MASSES, AND THE VAIONT ROCK SLIDE,
C. Jaeger.
Civ Eng Public Works Rev, Vol 64, No 761, p 1204-1207, Dec 1969. 4 p, 13 fig, 1 tab, 10 ref.

Descriptors: Stability, Stability analysis, *Slope stability, Banks, Earth movements, Mass wasting, *Landslides, *Rockslides, Rock mechanics, Soil mechanics, *Reservoirs, *Bank stability, Failures, Uplift pressure, Pore pressure, Pore water pressures, Engineering geology, Theory, Creep, Brittle failures, Failure (Mechanics).
Identifiers: Rock slope stability, Failure surfaces, *Vaiont slide, Italy.

Examination of conditions at the Vaiont slide in Italy shows that the usually accepted approach to the stability of reservoir banks is inadequate for explaining rock movements preceding and on the day of the explosive slide. The usually accepted approach and some general probleming concerning rockslides are discussed. Several papers are cited concerning the Vaiont slide. The event is described as starting with a small partial slide of the continuous visco-plastic type during the first partial filling of the reservoir. Movement and stabilization of the rock masses corresponded to raising and lowering of the reservoir water level respectively until just prior to failure, when lowering of the water level did not stop movement. A hypothesis of discontinuous movement of the rock masses is the only possible assumption in this case becuase continuous creep occurring along a concave sliding surface cannot accelerate suddenly. Uplift forces caused progressive deterioration of rock strength on the lower section of the sliding surface until a fragile rupture occurred, permitting a sudden acceleration of the rock masses. (USBR)
W70-10130

DETERMINING IN-SITU ROCK STRENGTH,
Falconbridge Nickel Mines Ltd.
K. H. S. Deshwar.
Eng Mining J, Vol 171, No 5, p 84-85, May 1970. 2 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Rock mechanics, *Rock properties, Displacements, Poisson ratio, Rocks, Strength, Elasticity modulus, Discontinuities, Compressive strength, Laboratory tests, Methodology, Mechanical properties, Tensile strength, Youngs modulus, Elastic deformation.
Identifiers: *In situ rock, Empirical equations, Comparative studies, *Empirical methods, Elastic coefficient, Underground openings.

A simple technique for determining the in situ strength and elastic constants of rock structures is presented. The method is more accurate than present laboratory tests and considerably less expensive than field tests. The method is based on an empirical relationship between massive and small-scale properties of various rocks developed by Protodyakonov after a comprehensive investigation into the effects of planes of weakness on rock masses. Using in situ rock properties determined by the method, displacements of an underground excavation were computed by the finite element method and compared to measured displacements. Results show that the method gives a good approximation of in situ rock properties. (USBR)
W70-10132

RIVER MOUNTAINS TUNNEL,
Fluor Utah Engineers and Constructors, Inc., Henderson, Nev.
P. E. Sperry.
Proceedings, II Symporium on Rapid Excavation, p 11-1-11-12, Sacramento State College, Calif, Oct 1969. 12 p, 5 fig.

Descriptors: *Tunnel construction, Tunneling, *Tunneling machines, *Tunnels, Construction equipment, Construction, Surveying, Costs, Dust control, Engineering geology, Ventilation, Rock excavation, Rock bolts, Production, Laser.

Identifiers: *Construction methods, Cost savings, Cutters, Rapid excavation, *River Mountains Tunnel, Nev.

The 19,970-ft-long, 10-ft-dia River Mountains Tunnel, a key feature of the Southern Nevada Water Project, was excavated by a mechanical boring machine through rock thought to be too hard to mole. The tunnel traverses extrusive volcanic rocks of complex and variable geology. Individual rock types had extreme variations in hardness and drillability. Tunneling equipment, construction procedures, dust control, rock support, and alinement control are described. The mole had an availability of 80%. Most downtime was caused by failure of the drive pinion resulting from unanticipated high torque loads in drilling soft tuffs; remaining downtime was caused by repairs to the hydraulic system. Cutter life was longer than expected, resulting in an average cutter cost of less than $15 per foot of tunnel. Production of the mole varied from 10 ft per day in moist tuffs to 23 ft per hr in ideal moling rock. Careful construction planning had allowed for most problems encountered during the excavation, and the tunnel was holed through on schedule at a cost of $90 per ft, an estimated savings of $50 per ft over usual tunnel excavation methods. (USBR)
W70-10137

PROBING THE MEDITERRANEAN'S HIDDEN GEOLOGICAL PAST.
For primary bibliographic entry see Field 02J.
W70-10184

REVIEW OF COLLAPSING SOILS,
California State Coll., Long Beach. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02G.
W70-10256

8F. Concrete

THIN UNDERWATER CONCRETE STRUCTURES,
Massachusetts Inst. of Tech., Cambridge.
Odd E. Gjorv.
Proceedings, American Society of Civil Engineers, Journal of the Construction Division, Vol 96, No CO1, p 9-17, June 1970. 9 p, 5 fig, 1 tab, 8 ref, append.

Descriptors: *Underwater construction, Concrete construction, Tremie concrete, Portland cements, *Concrete structures, Performance, Piers, Durability, Corrosion, Inspection, Reinforcement, Cast-in-place structures, Underwater, Sea water.
Identifiers: *Construction methods, Undersea aqueduct (Collective), Corrosion environments, Sulfate-resisting cements.

During the past half century, more reinforced concrete wharves and piers of the slender-pillar type have been constructed in Norwegian harbors than all other types of wharves put together. The method of pouring the slender, reinforced concrete pillars underwater has made this type of wharf construction economically favorable. A comprehensive field inspection of 219 older structures of this type was made. The overall good condition observed proves that concrete can be placed successfully underwater, even for reinforced concrete members having relatively narrow cross sections. The findings emphasize that a proper casting technique is essential, and that sulfate-resisting cements are generally preferable in this type of underwater construction, even in cold climates. (USBR)
W70-10150

8G. Materials

MINIMIZING ERRORS IN GAMMA-RAY SURFACE-TYPE DENSITY GAGES: EXISTING GAGES AND NEW DESIGN CONCEPTS,
North Carolina State Univ., Raleigh.
William L. Dunn, and Frank H. McDougall.
Highway Research Record, No 301, p 40-52, 1970. 13 p, 3 fig, 8 tab, 6 ref.

Descriptors: *Densimeters, *Gamma rays, Soil density, Reviews, Errors, Design, *Gages, Instrumentation, Nuclear energy, Measurement, Radiation, Radiation measurement, Calibrations, Standards, Electronic equipment, Soil mechanics.
Identifiers: *Nuclear density meters, Backscattering, Spectrometry, Accuracy, Air gaps.

Backscatter-type nuclear density gages have been in existence for many years, but have been slow in gaining widespread commercial acceptance because accuracy of the gages has not been satisfactory. Research on identifying, measuring, and minimizing gage errors is reviewed, and suggestions for improving gage accuracy on present-generation commercial gages are included. The dual-gage principle offers much promise for improving gage performance. Optimum dual-gage systems are being designed on the basis of maximizing a quality factor that is a function of all gage errors and the measurement volume. Two prototype gages were constructed to aid in the evaluation. Results from initial testing of both systems are presented, indicating that a significant improvement in accuracy is possible. Present capabilities of gamma-ray surface-type density gages are summarized, techniques that may be applied to existing gages for obtaining the best possible performance are discussed, and new design concepts for developing more accurate and efficient gages are proposed. (USBR)
W70-10143

10. SCIENTIFIC AND TECHNICAL INFORMATION

BOREHOLE DILUTION TECHNIQUES: A CRITICAL REVIEW,
International Atomic Energy Agency, Vienna (Austria); Federal Experimental and Research Inst., Vienna (Austria); and Institute of Nuclear Research, Kracow (Poland).
For primary bibliographic entry see Field 07B.
W70-10103

REMOTE SENSING OF EARTH RESOURCES, A LITERATURE SURVEY WITH INDEXES.
National Aeronautics and Space Administration, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-10126

ANNUAL CYCLE OF PHYTOPLANKTON AND OF PRIMARY PRODUCTION IN TROPICAL SEAS (IN FRENCH),
Museum National d'Histoire Naturelle, Paris (France). Laboratoire des Peches Outre-Mer.
For primary bibliographic entry see Field 02K.
W70-10172

ENVIRONMENTAL POLLUTION-A SELECTIVE BIBLIOGRAPHY.
Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. Information Services Section.

May 1970. 32 p.

Descriptors: *Bibliographies, *Water pollution, *Air pollution, Pesticides, Population, Radioactive wastes, Waste disposal, Waste treatment, Oily water, Thermal pollution, Pollution abatement.
Identifiers: Pollution bibliography, Environment pollution.

This bibliography of approximately 300 items, lists federally sponsored research in air and water pollution by such departments and agencies as HEW, Interior, AEC, NASA, Defense, Transportation and others. These reports do not represent all that are available from the Clearinghouse, but were selected from those appearing in our announcement journals during the period 1968 through April 1970. Unless ,otherwise specified, reports are available from the Clearinghouse. Ordering instructions are given. Specific pollution topics listed include engine exhausts, sulfur oxides, noise, pesticides, population, radioactive contamination, wastes (general), wastes (treatment), water pollution (general), water pollution (oil), and water pollution (thermal). (Knapp-USGS)
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A REVIEW OF CHLORINATED BIPHENYL CONTAMINATION IN NATURAL WATERS,
Wisconsin Univ., Madison, Water Chemistry Lab.
For primary bibliographic entry see Field 05B.
W70-10277

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION 1966-1968, UNITED STATES AND CANADA.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-10318

A REVIEW OF THE LITERATURE OF 1966 ON WASTE WATER AND WATER POLLUTION CONTROL,
For primary bibliographic entry see Field 05D.
W70-10437

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